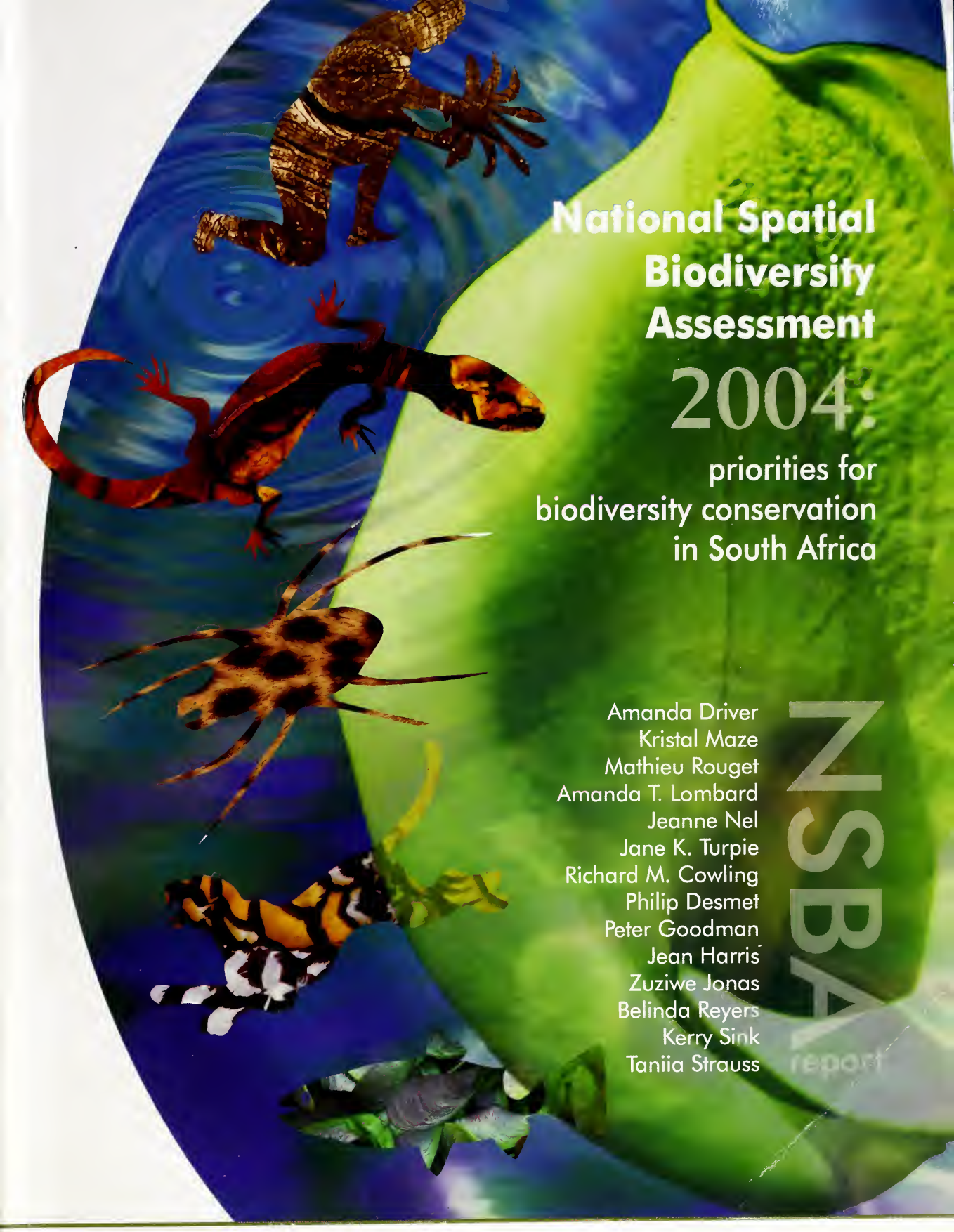

National Spatial Biodiversity Assessment 2004:

priorities for biodiversity conservation in South Africa

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NSBA report

STRELITZIA 17

Acronyms

ARC Agricultural Research Council

C.A.P.E. Cape Action for People and the Environment

CBD Convention on Biological Diversity

CERM Consortium for Estuarine Research and Management

CR Critically endangered

CSIR Council for Scientific and Industrial Research

DACE Department of Agriculture, Conservation and Environment

DEAT Department of Environment Affairs and Tourism

DWAF Department of Water Affairs and Forestry

EEZ Exclusive Economic Zone

EIP Environmental Implementation Plan

EMP Environmental Management Plan

EN Endangered

GIS Geographic Information System

IDP Integrated Development Plan

LT Least threatened

MDG Millennium Development Goal

MDTP Maloti-Drakensberg Transfrontier Project

MEC Member of the Executive Committee

MPA Marine protected area

NAPCCD National Action Plan: Convention on Combating Desertification

NBSAP National Biodiversity Strategy and Action Plan

NEMA National Environmental Management Act

NGO Nongovernmental Organisation

NSBA National Spatial Biodiversity Assessment

NSDP National Spatial Development Perspective

QDS Quarter degree square

SALGA South African Local Government Association

SANBI South African National Biodiversity Institute

SANDF South African National Defence Force

SDF Spatial Development Framework

SKEP Succulent Karoo Ecosystem Programme

STEP Subtropical Thicket Ecosystem Programme

VU Vulnerable

WMA Water Management Area

WRC Water Research Commission

STRELITZIA 17

National Spatial Biodiversity Assessment 2004:

priorities for biodiversity conservation in South Africa

by

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STRELITZIA

This series has replaced *Memoirs of the Botanical Survey of South Africa* and *Annals of Kirstenbosch Botanic Gardens* which were inherited from predecessor organisations.

The plant genus *Strelitzia* occurs naturally in the eastern parts of southern Africa. It comprises three arborescent species, known as wild bananas, and two acaulescent species, known as crane flowers or bird-of-paradise flowers. The logo of the South African National Biodiversity Institute is based on the striking inflorescence of *Strelitzia reginae*, a native of the Eastern Cape and KwaZulu-Natal that has become a garden favourite worldwide. It symbolises the commitment of the Institute to promote the sustainable use, conservation, appreciation and enjoyment of the exceptionally rich biodiversity of South Africa, for the benefit of all people.

The National Spatial Biodiversity Assessment was commissioned by the Department of Environmental Affairs and Tourism as part of the National Biodiversity Strategy and Action Plan. It was co-funded by the Department of Environmental Affairs and Tourism and the South African National Biodiversity Institute.

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Abstract

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Keywords: biodiversity, conservation, estuarine, freshwater, marine, South Africa, terrestrial.

This report presents the results and recommendations of South Africa's first National Spatial Biodiversity Assessment (NSBA). The NSBA is the first ever comprehensive spatial assessment of biodiversity throughout the country. It has four components, dealing with the terrestrial, freshwater, estuarine and marine environments. For each of these environments, the current status and protection levels of ecosystems are assessed, and priorities for conservation action are identified. Conservation action is not limited to the establishment of protected areas, but includes wise management of land and natural resources throughout the landscape and seascape.

It is hoped that the spatial products presented in the report will be widely used and built upon. The challenge that lies ahead is to translate the biodiversity priorities identified here into conservation action on the ground. This will involve mainstreaming biodiversity priorities in the policies, plans and actions of a wide range of stakeholders, both public and private, whose core business is not biodiversity, but whose day-to-day decisions will ultimately determine whether our development path is a sustainable one.

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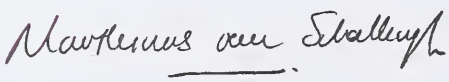
Foreword by the Minister of Environmental Affairs & Tourism

South Africa is blessed with extraordinary natural wealth, not least our biodiversity resources. These resources play a vital role in meeting basic human needs through the delivery of ecosystem services.

The challenge we face is how to manage these resources strategically in support of our country's sustainable development goals. Conserving and managing biodiversity must be a cornerstone of our sustainable development strategy. Although the challenges ahead are immense, this report provides us with priorities and practical advice on how this can be achieved.

This report is South Africa's first national spatial assessment of biodiversity priorities including marine, freshwater, estuarine and terrestrial environments. It is a groundbreaking assessment that rests on many years of solid research and biodiversity management experience in South Africa.

It makes a significant contribution to strategically direct the biodiversity management efforts in South Africa and assists us in implementing the Biodiversity Act as well as our obligations under the Convention on Biological Diversity. The assessment will serve as a resource and will be a useful tool in policy and decision-making across the spheres of government.



Marthinus van Schalkwyk
Minister of Environmental Affairs & Tourism

10 March 2005

Executive Summary

1. Introduction

This report presents the results and recommendations of South Africa's first National Spatial Biodiversity Assessment (NSBA), led by the South African National Biodiversity Institute (SANBI). The NSBA is the first ever comprehensive spatial assessment of biodiversity throughout the country. It has four components, dealing with the terrestrial, freshwater, estuarine and marine environments.

The NSBA should inform the policies, plans and day-to-day activities of a wide range of sectors, both public and private. It is hoped that the spatial products presented in this report will be widely used and built upon. The focus is on mainstreaming biodiversity priorities throughout the economy, and making links between biodiversity and socio-economic development. In a country like South Africa, with its extraordinary biodiversity resources, there is no need to see addressing socio-economic development challenges and conserving biodiversity as opposing goals. Rather, they can reinforce each other, so that conserving biodiversity strengthens the economy, contributes to social development, and becomes a cornerstone of our sustainable development path.

2. What is a spatial assessment?

Biodiversity, like people and economic activity, is not evenly distributed across the landscape or seascape, but occurs in greater concentrations in some areas than others. A spatial biodiversity assessment takes these geographic variations into account by *mapping* information about biodiversity features (such as species, habitats and ecological processes), protected areas, and current and future patterns of land and resource use. This mapped information is then analysed using tools linked to a Geographic Information System (GIS), to help determine geographic priority areas for action.

Spatial assessments or analyses can take place at different spatial scales, from global to local. A national biodiversity assessment is intended to be broad. It provides a national context for assessments at the subnational scale, and points to broad priority areas where further investigation, planning and action is warranted.

3. South Africa's approach to biodiversity planning

There are several possible approaches to biodiversity planning. The approach used most often in South Africa, including in the NSBA, is **systematic biodiversity planning**. It is based on three key principles:

- The need to conserve **a representative sample** of biodiversity pattern, such as species and habitats (the principle of representation).
- The need to conserve the **ecological and evolutionary processes** that allow biodiversity to persist over time (the principle of persistence).
- The need to set quantitative **biodiversity targets** that tell us how much of each biodiversity feature should be conserved in order to maintain functioning landscapes and seascapes.

Another important aspect of South Africa's approach to biodiversity planning is a **focus on ecosystems** in addition to species. The single biggest cause of biodiversity loss is loss **or degradation of natural habitat and ecosystems**, so it often makes sense to focus conservation action on ecosystems rather than individual threatened species. There are exceptions to this, especially in the marine environment.

4. Key strategies for conserving South Africa's biodiversity

Three key strategies for conserving South Africa's biodiversity emerge from the NSBA:

- **Pursue opportunities to link biodiversity and socio-economic development in priority geographic areas.** This involves working with production sectors, private and communal landowners, and other users of land and resources to conserve biodiversity in the context of production landscapes and seascapes, and is often referred to as 'mainstreaming biodiversity'.
- **Focus emergency action on threatened ecosystems, to prevent further loss of ecosystem functioning.** Threatened ecosystems are found most often in the midst of production landscapes and seascapes, and are often already fragmented or degraded. Emergency action to prevent further loss of functioning will involve use of the new tools provided by the Biodiversity Act to influence day-to-day decisions about the use of land and resources in these ecosystems (see Section 5 below).
- **Expand the formal protected area network.** The results of the NSBA show that our protected area network does not conserve a representative sample of South Africa's biodiversity, especially in the marine environment. Note that formal protected areas need not be state owned (see Section 5 below.) Expansion of the protected area network needs to involve local communities as key stakeholders.

Cross-cutting activities needed to support these strategies are:

- **Building the capacity of local government to include biodiversity opportunities and constraints in integrated development planning.** The results of the NSBA can help to identify municipalities that require such support most urgently.
- **Filling key information gaps to strengthen future biodiversity assessments.** The most significant information gap is reliable, up-to-date information about where ecosystems have been lost or degraded.

5. Links to policy and legislation

The NSBA relates to many South African laws and policies in various sectors. Here we touch on the **Biodiversity Act** (10 of 2004) and the **Protected Areas Act** (57 of 2003), which together give us powerful tools for achieving management and conservation of biodiversity in production landscapes. A key provision in the Biodiversity Act allows the Minister or an MEC to list threatened and protected ecosystems. This gives us a powerful mechanism to address biodiversity conservation effectively and efficiently, at the ecosystem scale. The Act does not specify how threatened ecosystems should be identified; the NSBA, together with existing systematic biodiversity plans at regional and local scale, provides an excellent starting point for this, based on best available science.

The Protected Areas Act provides for any land, including private or communal land, to be declared a formal protected area, and allows for co-management of such a protected area by the landowner(s) or any suitable person or organisation. This means that formal protected area status, with an associated rates exclusion in terms of the Rates Act, is not limited to state-owned land, and that government agencies are not the only organisations that can manage protected areas.

The NSBA provides a valuable set of indicators, such as ecosystem status and protection levels of ecosystems, that can feed into State of Environment Reports, and into Environmental Management Plans and Environmental Implementation Plans required in terms of the National Environmental Management Act (107 of 1998). The NSBA will be regularly updated by SANBI.

6. Terrestrial biodiversity assessment

Thirty-four percent of South Africa's 440 terrestrial ecosystems are threatened. Of these, 5% are critically endangered (mostly in the fynbos and forest biomes), 13% are endangered (mostly in the grassland and savanna biomes), and 16% are vulnerable (mostly in the fynbos and grassland biomes).

The total percentage of South Africa's land area in protected areas is nearly 6%. However, the percentage of well protected ecosystems is higher, at 15%. Most of these well protected ecosystems are in the fynbos mountains and the savanna biome, while the most severely under-protected ecosystems tend to be in the succulent karoo, the grasslands, and the fynbos lowlands.

We suggest five inter-linked sets of actions to conserve terrestrial biodiversity in priority areas:

- **Work with production sectors** that are major land users (such as agriculture, infrastructure and property development, forestry and mining), to develop and implement sector-specific wise-practice guidelines to minimise loss of natural habitat and species in threatened ecosystems, and to protect ecosystem functioning.
- **Strengthen bioregional programmes.** Bioregional programmes are multisectoral programmes that provide a framework for collaborative conservation action, often across administrative or political boundaries. Existing bioregional programmes are C.A.P. E., STEP, SKEP and the Maloti-Drakensberg Transfrontier Project; emerging ones include the Wild Coast Conservation and Sustainable Development Project and the National Grasslands Initiative. Local and district municipalities should be seen as key stakeholders in bioregional programmes.
- **Minimise loss of habitat in threatened ecosystems.** This can be achieved through at least two mechanisms: by promoting stewardship among private and communal landowners, and by using regulations in terms of the Biodiversity Act to restrict certain land uses in listed threatened ecosystems.
- **Prevent and manage the spread of invasive alien species,** by focusing alien clearing efforts, such as Working for Water, on areas where socio-economic needs coincide with areas of high biodiversity priority.

- **Expand formal protected areas to achieve biodiversity targets**, in consultation with implementing agencies such as SANParks and provincial conservation agencies.

7. River biodiversity assessment

The river component of the NSBA is based on the work of the DWAF-CSIR-WRC National Freshwater Biodiversity Initiative. Of South Africa's 120 river signatures, 82% are threatened. A disturbing 44% are critically endangered, 27% are endangered, 11% are vulnerable, 18% are least threatened.

Our river ecosystems are in a much poorer state overall than our terrestrial ecosystems, reflecting the fact that South Africa is a water-scarce country. Water is South Africa's most critical natural resource. Quality, quantity and sustainability of water resources are fully dependent on **good land management practices within catchments.** The fate of our country's natural water resources therefore relies on an integrated approach to managing water and land, to achieve ecological and socio-economic sustainability. We need to pay increased attention to managing rivers for meeting immediate social and economic needs as well as maintaining their long-term functioning to meet the needs of future generations. The establishment of Catchment Management Agencies, which will develop Catchment Management Strategies, is an important step towards achieving this.

We emphasise the following sets of actions to conserve river biodiversity and functioning:

- **Integrate land and water policy and management, as a basis for integrated management strategies.** The way we manage land has profound impacts on river biodiversity and the production of water. Since DWAF is the national custodian of inland water resources and DEAT is the national custodian of biodiversity, conservation of freshwater biodiversity cannot be successful without achieving some interface in policy and strategies between these two departments. Development of criteria for river management that address social, economic and ecological sustainability, would be one step towards achieving this.
- **Feed information from this assessment into DWAF's water resource classification system and Catchment Management Strategies**, to help determine how many rivers, and which rivers, need to be managed in a natural or moderately impacted state.
- **For mainstems that are heavily impacted, determine, implement and monitor ecological reserves** in terms of the National Water Act (1998), to ensure that these mainstems are managed in a way that allows for connectivity between tributaries that have been identified as biodiversity priorities.
- **Integrate rivers into bioregional plans and programmes** and fine-scale biodiversity assessments.

8. Estuarine biodiversity assessment

South Africa has 259 estuaries, divided into 13 groups. Three of these groups are critically endangered and five are endangered. The overall picture is less dramatic than for river ecosystems, but worse than for terrestrial ecosystems. Fourteen of the 259 estuaries have high levels of protection, but these protected estuaries are not evenly distributed across the different estuary groups; only two estuary groups are well protected.

Fortunately, many of the human activities associated with estuaries are compatible with their conservation, as long as the activities are managed appropriately. Use and conservation of estuaries can go together. In this context, the following priority actions are identified:

- **Determine, implement and monitor the freshwater reserve for priority estuaries,** in conjunction with the Consortium for Estuarine Research and Management (CERM). The National Water Act (1998) makes provision for a freshwater reserve for estuaries, but this has been set for only a handful of estuaries so far. Groups of estuaries that are critically endangered and not protected at all are likely to be the highest priorities in this regard.
- **Expand the number of protected estuaries, to maintain a core set of estuaries in a natural or near-natural state.** CERM has identified 32 estuaries that should make up this core set, 11 of which already have some level of protection. Extending appropriate levels of protection to the remaining 21 should be a priority action. This is likely to mean limits to certain human activities in these estuaries, but not necessarily maximum levels of protection.
- **Integrate resource management and land-use planning.** As with rivers, integrated planning and management of water and land throughout catchments is a priority if we are to maintain estuary functioning and value.

9. Marine biodiversity assessment

Sixty-five percent of South Africa's 34 marine biozones are threatened, with 12% critically endangered, 15% endangered, 38% vulnerable, and 35% least threatened. In general, biozones further from the shore are less threatened, as they are less accessible to human-related impacts.

Sixty-eight percent of marine biozones have either zero or poor protection. None of the Namaqua biozones (on the west coast) are protected, and offshore biozones are generally poorly protected, reflecting the fact that marine protected areas tend to hug the coast.

The overall picture for marine ecosystems is less dramatic than for rivers or estuarine ecosystems, but worse than for terrestrial ecosystems. Extractive marine living resource use is by far the biggest pressure on marine biodiversity. The main forms of extractive marine living resource use are commercial and recreational fishing. On the upside for marine ecosystems, some of the impacts of this extractive resource use are reversible. For example, as long as fish stocks are still above a certain threshold, they can and do recover if fishing effort is reduced. However, in the course of harvesting marine resources, irreversible damage is often done to the habitat, such as when the sea bed is trawled for fish. Our marine ecosystems play a vital direct economic role. We need to be careful that in extracting economic value from them now, we do destroy their long-term productive capacity. All indications are that this is a real danger that faces South Africa.

We suggest the following set of priority actions to conserve marine biodiversity:

- **Engage with the commercial fishing industry** to find ways to reduce negative impacts on marine biodiversity (both on fish stocks themselves, and on marine habitats, especially soft-bottom trawling grounds), thus contributing to the long-term health of the industry. Owing to the high number of species (~340)

used by South African fisheries, more species-level interventions may be required in the marine environment than in the terrestrial environment.

- **Engage with other industry sectors**, including the mining industry (especially the diamond industry on the west coast), the coastal property development sector, and the emerging mariculture industry, to develop and implement sector-specific wise-practice guidelines to reduce impacts on marine habitats.
- **Expand marine protected areas**, especially in the Namaqua bioregion, and beyond the coastal region into the deep sea region. Representative protection of the South African EEZ cannot be achieved with coastal MPAs that extend two or three nautical miles offshore. The proposed Namaqualand MPA will play an important role in this regard. We note that MPAs do not always ensure adequate protection of their biodiversity, and more effort needs to go into ensuring compliance within MPAs.
- As we have stressed in the terrestrial, river and estuarine components, an **integrated approach** to managing resources at the local level is required, especially for coastal regions not in MPAs. This will require support to coastal municipalities.

10. Next steps

SANBI's intention is to review and update the NSBA regularly, especially as better spatial information becomes available, for example on the integrity of terrestrial and marine habitats. There is also a need to further integrate the terrestrial, river, estuarine and marine components, for example by identifying overall priorities for all four environments combined. An integrated assessment needs to take into account the critical role of biodiversity in freshwater production, placing freshwater resources at the centre of the planning process.

Another important step is to make links between the NSBA and other spatial policies and planning instruments, such as the National Spatial Development Perspective and Provincial Spatial Development Frameworks. Parts of the NSBA are relevant at the local level and can be integrated in local Spatial Development Frameworks, particularly in areas where no fine-scale biodiversity planning has been done.

The NSBA provides a tool for ongoing monitoring and reporting on the state of biodiversity. We propose the development of a national biodiversity management scorecard, based on a set of headline indicators drawn from the NSBA. A first attempt is shown in Box 5 in the main report, to stimulate discussion.

The NSBA is a significant milestone of which South Africa can be proud. The challenge that lies ahead is to translate the biodiversity priorities identified here into conservation action on the ground. This will involve mainstreaming biodiversity priorities in the policies, plans and actions of a wide range of stakeholders whose core business is not biodiversity, but whose day-to-day decisions will ultimately determine whether our development path is a sustainable one.

1. Introduction

This report presents the results and recommendations of South Africa's first National Spatial Biodiversity Assessment (NSBA), led by the South African National Biodiversity Institute (SANBI). We hope that it will provide a call to action and a means of aligning the efforts of the diverse range of stakeholders involved in the wise management of our vast biological wealth, for the benefit of current and future generations.

The NSBA is South Africa's first national assessment of spatial priorities for conservation action that integrates terrestrial, river, estuarine and marine ecosystems. The assessment was done using available spatial data, biodiversity planning software and a series of expert and stakeholder workshops.

The NSBA goes hand in hand with the National Biodiversity Strategy and Action Plan (NBSAP), led by the Department of Environment Affairs and Tourism (DEAT). The development of the NBSAP is part of South Africa's obligations as a signatory to the Convention on Biological Diversity (CBD). It provides an overarching framework for the conservation and sustainable use of South Africa's biodiversity, and equitable sharing of benefits from use of genetic resources.[1] As far we know, South Africa is the first country to include a comprehensive spatial assessment of biodiversity in its NBSAP.

This assessment fed into the NBSAP and will inform the National Biodiversity Framework.[2] However, it is also a stand-alone document that can inform the policies, plans and day-to-day activities of a wide range of sectors, both public and private. It is hoped that the spatial products presented in this report will be widely used and built upon. A list of their possible applications is included in the Appendix. As will be seen from the sections that follow, the focus is on mainstreaming biodiversity priorities throughout the economy, and making links between biodiversity and socio-economic development. In a country like South Africa, with its extraordinary biodiversity resources (see Box 2), there is no need to see addressing socio-economic development challenges and conserving biodiversity as opposing goals. Rather, they can reinforce each other, so that conserving biodiversity strengthens our economy and contributes to social development.

Almost every corner of South Africa is packed with valuable biodiversity resources, but because of limited human and financial resources it makes sense to prioritise conservation action on areas of greatest opportunity for linking biodiversity and socio-economic development, and areas where biodiversity is under greatest pressure. This report highlights such areas. Our intention is not to undervalue or dismiss biodiversity in other parts of the country, but simply to provide a systematic way of prioritising short- to medium-term action.

We would like to stress that the NSBA is not in itself a strategy and action plan. It highlights geographic priority areas, which have been fed into the broader NBSAP process. The NBSAP has used these geographic priorities as one way of focusing the development of strategies and action plans.

A detailed discussion of the methodology and results is presented in the four-volume NSBA Technical

[1] For more on the NBSAP, see DEAT's website www.deat.gov.za.

[2] The development of a National Biodiversity Framework is required in terms of the Biodiversity Act—see Section 5.

Report. In this summary report we have purposefully kept technical detail and references to a minimum. The full set of reports and GIS layers is available on compact disk from SANBI (contact info@sanbi.org).

Box 1: What is biodiversity and why should we be concerned about it?

The term biodiversity refers to genes, species (plants and animals), ecosystems, and landscapes, and the ecological and evolutionary processes that allow these elements of biodiversity to persist over time. South Africa's biodiversity provides an important basis for economic growth and development, in obvious ways such as providing a basis for its fishing industry, rangelands that support commercial and subsistence farming, horticultural and agricultural industry based on indigenous species, the tourism industry, aspects of the film industry, and commercial and noncommercial medicinal applications of indigenous resources. Keeping our biodiversity intact is also vital for ensuring ongoing provision of ecosystem services such as production of clean water through good catchment management, prevention of erosion, carbon storage (to counteract global warming), and clean air. Loss of biodiversity puts aspects of our economy and quality of life at risk, and reduces socio-economic options for future generations.

People are ultimately fully dependent on living, functioning ecosystems and the services they provide. Loss of biodiversity leads to ecosystem degradation and subsequent loss of important services, which tends to harm the rural poor more directly—poor people have limited assets and are more dependent on common property resources for their livelihoods, while the wealthy are buffered against loss of ecosystem services by being able to purchase basic necessities and scarce commodities. Our path towards sustainable development, poverty reduction and enhanced human well-being for all, is therefore dependent on how effectively we conserve biodiversity.

2. What is a spatial assessment?

Biodiversity, like people and economic activity, is not evenly distributed across the landscape or seascape, but occurs in greater concentrations in some areas than others. A spatial biodiversity assessment takes these geographic variations into account by *mapping* information about:

- Biodiversity features (such as species, habitats and ecological processes).
- Existing protected areas.
- Current patterns of land and resource use.
- Likely future patterns of land and resource use.

This mapped information can then be analysed using tools linked to a Geographic Information System (GIS), to help determine geographic priority areas for action.

Spatial assessments or analyses can take place at different spatial scales, from the global scale to the local scale. A national biodiversity assessment is intended to be broad, and will not yield information about, for example, how to manage an individual parcel of land or a specific river or catchment. A national

Box 2: What's special about South Africa's biodiversity?

South Africa is diverse not only in terms of its people and culture, but also in terms of its biological resources and ecology. Indeed South Africa has one of the world's richest diversities of plants and animals. The richness of South Africa's biological resources is well documented in the Endangered Wildlife Trust's publication The *Biodiversity of South Africa 2002*,[3] which highlights key facts and figures for different ecoregions within South Africa, including marine and freshwater ecoregions. South Africa occupies about 2% of the world's land area, but is home to nearly 10% of the world's plants and 7% of the reptiles, birds and mammals. We have three globally recognised biodiversity hotspots; the Cape Floristic Region, which falls entirely within our boundaries; the Succulent Karoo, shared with our neighbour Namibia, and Maputaland-Pondoland, shared with Mozambique and Swaziland (for more on these and other global biodiversity hotspots see www.conservation.org). Our seas straddle three oceans, the Atlantic, the Indian and the Southern Ocean, and include an exceptional range of habitats, from cool-water kelp forests to tropical coral reefs. The southern African coast is home to almost 15% of known coastal marine species, providing a rich source of nutrition and supporting livelihoods of coastal communities.

[3] Endangered Wildlife Trust. 2002. *The biodiversity of South Africa 2002: indicators, trends and human impacts*. Struik, Cape Town.

assessment does provide a national context for assessments at the subnational scale, and points to broad priority areas where further investigation, planning and action are warranted.

We are fortunate in South Africa to have a strong focus on spatial planning for all sectors at various levels, from the national to the local. We have a National Spatial Development Perspective (NSDP), which establishes principles to guide investment in social and economic infrastructure and development spending.[4] At the local level, every municipality must produce an Integrated Development Plan (IDP) that includes a Spatial Development Framework (SDF). This recognition of the importance of spatial planning presents an exciting opportunity to integrate spatial information on biodiversity priorities into cross-sectoral spatial plans at different spatial scales.[5]

3. South Africa's approach to biodiversity planning

South Africa is at the forefront of biodiversity planning[6] internationally, and the methods and techniques used in this assessment are at the cutting edge of the discipline. The NSBA rests on decades of research and innovation by South African scientists, often in collaboration with colleagues from other countries.

There are several possible approaches to biodiversity planning. The approach used most often in South Africa, including in this assessment, is referred to as **systematic biodiversity planning**.[7] Systematic biodiversity planning is based on three key principles:

- The need to conserve a **representative sample** of biodiversity pattern, such as species and habitats (the principle of representation).
- The need to conserve the **ecological and evolutionary processes** that allow biodiversity to persist over time (the principle of persistence).
- The need to set quantitative **biodiversity targets** that tell us how much of each biodiversity feature should be conserved in order to maintain functioning landscapes and seascapes. These biodiversity targets should ideally be based on best available science, rather than on arbitrarily defined thresholds (such as 10% of all features).

The NSBA is the first ever comprehensive spatial assessment of biodiversity throughout South Africa.

Photo Richard Lechmere-Oertel

[4] *National Spatial Development Perspective: spatial guidelines for infrastructure investment and development*. March 2003. Published by the Presidency (Policy Co-ordinatian and Advisary Services).

[5] A challenge for the biadiversity sector is to present spatial biodiversity infarmation in a way that is meaningful and relevant for spatial planners in other sectors, and to work constructively with these other sectors to integrate biadiversity priarities. Pilot projects to develop tools and mechanisms for this are currently under way in the C.A.P. E., STEP, SKEP and Malati-Drakensberg bioregional programmes. SANBI provides technical suppart for this through partnerships with relevant departments and institutians.

[6] Alsa referred to as canservation planning. We prefer ta use biodiversity planning, because in people's minds the term conservation planning is often associated purely with planning for the establishment ar expansion of formal protected areas, rather than with influencing the way resources are used and managed throughout the landscape or seascape.

[7] For an introductian to systematic biodiversity planning and a review of South African experience, see Driver, A. Cowling, R.M. & Maze, K. 2003. *Planning for living landscapes: perspectives and lessons from South Africa*. Center for Applied Biodiversity Science at Conservation Internatianal, Washingtan, DC; Batanical Society of South Africa, Cape Town. Available at www.botanicalsociety.org.za (under Conservation Unit, then Downloads). For a seminal article on systematic conservation planning, see Margules, C.R. & Pressey, R.L. 2000. Systematic conservation planning. *Nature* 405: 243–253.

Photo Belinda Reyers

It has four components, dealing with four distinct biological environments:

- Terrestrial (land).
- Freshwater (rivers and wetlands).[8]
- Estuarine (the interface between rivers and sea).
- Marine (sea).

Systematic biodiversity planning techniques are more advanced for terrestrial environments than for freshwater, estuarine and marine environments. The NSBA is the first attempt of which we know that deals with all four environments in one assessment, and has contributed to furthering the application of systematic planning in freshwater, estuarine and marine environments.

Another important aspect of South Africa's approach to biodiversity planning, is a **focus on ecosystems** in addition to species. This is consistent with the ecosystem approach of the Convention on Biological Diversity.[9] The single biggest cause of loss of biodiversity in South Africa, and in most of the world, is **loss or degradation of natural habitat and ecosystems**. Other important causes of loss of biodiversity are alien invasive species, which often disrupt ecosystem functioning, and over-extraction of natural resources, especially in the marine environment. Historically, conservation efforts have often focused on individual species, often charismatic ones that catch people's imagination, such as large mammals. While it is important to use all suitable spatial data on species and ecosystems in biodiversity planning, the most effective way to conserve the most biodiversity is often to focus conservation action on **threatened ecosystems** rather than individual threatened species.[10] Especially in a country like South Africa that has thousands of threatened species, focusing conservation action only on species is unlikely to be efficient or effective. We will return to this theme of threatened ecosystems throughout the report.

4. Key strategies for conserving South Africa's biodiversity

Three key strategies for conserving South Africa's biodiversity emerge from this assessment:

1. Pursue opportunities to link biodiversity and socio-economic development in priority geographic areas.
2. Focus emergency action on threatened ecosystems, to prevent further loss of ecosystem functioning.
3. Expand the protected area network.

These strategies are outlined briefly here and discussed further in the sections on 'What are the priority actions?' for the terrestrial, river, estuarine and marine environments. A key cross-cutting issue is the need to build the capacity of all spheres of

[8] Limited available spatial data on wetlands meant that it was not possible to do a full assessment of wetlands. Wetlands were incorporated in the terrestrial analyses to a limited extent, but should be addressed more fully in future revisions of the NSBA.

[9] The ecosystem approach of the Convention on Biodiversity, developed internationally in the 1980s, is 'based on the application of appropriate scientific methodologies focused on levels of biological organisation that encompasses the essential processes and interactions among organisms and their environment'. An ecosystem is defined as 'a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit' (CBD 2003: 5). The recognition that humans are an integral part of ecosystems is also a key feature of the approach. The ecosystem appraach can be used at varying scales.

[10] We note that there are exceptions, especially in the marine environment where high numbers of species are specifically targeted for extraction from their habitat, and species-level interventions may therefore be required.

government, but especially local government, to include biodiversity opportunities and constraints in integrated development planning, also discussed briefly below. Lastly we touch on the need to fill some important information gaps in order to strengthen future biodiversity assessments.

Strategy 1: Pursue opportunities to link biodiversity and socio-economic development in priority geographic areas

This involves working with production sectors, private and communal landowners, and other users of land and resources, to conserve biodiversity in the context of production landscapes and seascapes, and is often referred to as 'mainstreaming biodiversity'.

We have identified nine terrestrial biodiversity priority areas (see Section 6). These areas have high concentrations of biodiversity pattern, and house some of the country's most important ecological infrastructure. They present opportunities for multisectoral bioregional programmes, which involve working with conservation agencies, industry sectors and local communities to build the biodiversity economy. Ensuring access to the natural environment, and tangible benefits to all from the biodiversity economy, especially those excluded in the past, should be a major thrust of bioregional programmes. Some bioregional programmes are already under way, such as Cape Action for People and the Environment (C.A.P. E.)[11] in the Cape Floristic Region, the Succulent Karoo Ecosystem Programme (SKEP),[12] the Subtropical Thicket Ecosystem Programme (STEP),[13] and the Maloti-Drakensberg Transfrontier Project (MDTP),[14] and others are emerging, for example the Wild Coast Conservation and Sustainable Development Project and the National Grasslands Initiative.

Some of the biodiversity priority areas have a special role to play in producing the country's water. In these, Catchment Management Agencies will have a key role to play. The river component of the NSBA points to some of the Water Management Areas that need attention most urgently, and emphasises the need to pay increased attention to managing rivers for meeting immediate social and economic needs as well as maintaining their long-term functioning to meet the needs of future generations (see Section 7).

In the marine environment, the links between maintaining the natural resource base and ongoing productivity of key industries such as the fishing industry, are particularly stark. The marine component of the NSBA highlights geographic priorities as well as industry sectors with which we should engage constructively.

Strategy 2: Focus emergency action on threatened ecosystems, to prevent further loss of ecosystem functioning

Threatened ecosystems are found most often in the midst of production landscapes and seascapes, and are often already fragmented or degraded. Emergency action to prevent further loss of functioning will involve use of the tools provided by the new Biodiversity Act (for example, listing of threatened ecosystems and species, implementation of biodiversity management plans—see Section 5),

Photo Belinda Reyers

[11] See www.capeactian.org.za
[12] See www.skep.org
[13] See http://cpu.uwc.ac.za
[14] See www.maloti.org

Photo Richard Lechmere-Oertel

to influence day-to-day decisions about the use of land and resources in these ecosystems. Stewardship of threatened ecosystems by individuals, communities and local authorities that work in them and manage them, is key to ensuring their survival. We hope that popularising the concept of threatened ecosystems and providing clear maps and accompanying information of where and what they are, will in itself begin to influence behaviour and decisions.

Strategy 3: Expand the formal protected area network[15]

The results of the NSBA show that our protected area network does not conserve a representative sample of South Africa's biodiversity. We recognise that a range of factors influence where and how protected areas are established and expanded; the goal of representation should be one of these. The marine environment has the lowest levels of protection currently, especially offshore.

Formal protected areas need not be state-owned. Using new tools in the Protected Areas Act, it is possible to establish formal private and communal protected areas—see Section 5. Protected areas should bring benefits to surrounding communities. In expanding and managing the protected area network, it is important to focus on local communities as key stakeholders.

This set of three strategies brings home the fact that conserving biodiversity is not just about protected areas. Protected areas play a vital role, and a well managed protected area network that includes a representative sample of all ecosystems is an important goal. However, we will never conserve biodiversity effectively through protected areas alone. Conserving biodiversity involves working with users of land and resources, from local communities who rely directly on natural resources for their livelihoods, to business and industry, to conserve priority areas and manage biodiversity in a way that maintains ecosystem functioning within the production landscapes and seascapes in which people live and work.

Supporting activity 1: Build the capacity of local and provincial government to include biodiversity opportunities and constraints in integrated development planning

Strategies 1 and 2 rely in part on building capacity of municipalities to include biodiversity opportunities and constraints in their integrated development planning. Local government has a key role to play in conserving biodiversity, because day-to-day decisions about the use of land and resources at the local level often determine whether biodiversity is lost or wisely managed. The NBSAP includes a major thrust to support municipalities in their efforts to integrate biodiversity priorities in their IDPs, SDFs, and day-to-day decision-making. DEAT, SANBI and the South African Local Government Association (SALGA) are well placed to develop in partnership such a capacity-building programme for municipalities. The results of this assessment can help to identify municipalities—for example, those with higher numbers of threatened ecosystems—that require such support most urgently.

[15]The IUCN defines a protected area as an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity and of natural and associated cultural resources, and managed thraugh legal or other effective means. Our emphasis in this strategy is on formal protected areas with secure long-term legal status, whether these are publicly, privately or communally owned.

Supporting activity 2: Fill key information gaps to strengthen biodiversity assessment

Another focus area relates to information gaps that hold us back from developing a full picture of our biodiversity resources and constraints. Key gaps for each component are highlighted in Sections 6, 7, 8 and 9. The most important gap is, interestingly, *not* information about where different habitats and species are located, but rather reliable, up-to-date information about where ecosystems have been lost or degraded, especially for terrestrial, river and marine environments. For example, in the terrestrial biodiversity assessment we have used the 1996 National Land Cover to assess where natural habitat has been lost. This is clearly not ideal—since 1996 there have been significant changes in land use in many parts of the country. The 2000 National Land Cover (based on a satellite image taken in 2000) is not yet available, and by the time it is available it will be substantially out of date. It is crucial that we find a way of tracking changes in natural habitat throughout the country at an appropriate spatial scale that yields data that are not several years out of date by the time they are published.

5. Links to policy and legislation

The NBSAP and the NSBA relate to many South African laws and policies across different sectors, and a comprehensive review will not be attempted here. For more information, see the country study that forms part of the NBSAP documentation, available on DEAT's website www.deat.gov.za. In this section, attention is drawn to two key pieces of legislation, the Biodiversity Act and the Protected Areas Act, both part of the suite of National Environmental Management legislation. We also highlight the ability of the NSBA to provide biodiversity indicators and to contribute to South Africa's international commitments.

The Biodiversity Act and the Protected Areas Act

The Biodiversity Act (10 of 2004) establishes SANBI, making South Africa one of the few countries in the world to have a national public sector institute dedicated to biodiversity. The Act gives SANBI a key role in monitoring and reporting on the status of the country's biodiversity as well as in supporting national and bioregional policy, planning and programmes. SANBI's role is one of co-ordination and facilitation, working in partnership with a range of existing biodiversity and other institutions.

Chapter 4 of the Biodiversity Act deals with threatened ecosystems and species. One of the key provisions in this Chapter allows the Minister or an MEC to list threatened and protected ecosystems—see Box 3. This provision gives us a powerful mechanism to address biodiversity conservation effectively and efficiently, at the ecosystem scale. The Act does not specify how threatened ecosystems should be identified; the NSBA, together with existing systematic biodiversity plans at regional and local scale, provides an excellent starting point for this, based on best available science.

The Biodiversity Act also provides for a National Biodiversity Framework, statutory bioregional plans (for which the NSBA provides a national context), and statutory biodiversity management plans for threatened ecosystems or species.

Photo Philip Desmet

Box 3: Threatened and protected ecosystems in the Biodiversity Act

The Biodiversity Act includes the following provisions for listing of threatened and protected ecosystems:

52 (1) (a) The Minister may, by notice in the Gazette, publish a national list of ecosystems that are threatened and in need of protection.

(b) An MEC for environmental affairs in a province may, by notice in the Gazette, publish a provincial list of ecosystems in the province that are threatened and in need of protection.

52 (2) The following categories of ecosystems may be listed in terms of subsection (1):

(a) critically endangered ecosystems, being ecosystems that have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to an extremely high risk of irreversible transformation;

(b) endangered ecosystems, being ecosystems that have undergone degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems;

(c) vulnerable ecosystems, being ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems; and

(d) protected ecosystems, being ecosystems that are of high conservation value or of high national or provincial importance, although they are not listed in terms of paragraphs (a), (b) or (c).

The Protected Areas Act (57 of 2003) establishes a streamlined set of categories for protected areas. A range of different protected area options are available, both for strict protection as well as more flexible biodiversity management. The Act provides for any land, including private or communal land, to be declared a formal protected area, and allows for co-management of such a protected area by the landowner(s) or any suitable person or organisation. This means that formal protected area status, with an associated rates exclusion in terms of the Rates Act, is not limited to state-owned land, and that government agencies are not the only organisations that can manage protected areas.

The Biodiversity Act provisions on threatened ecosystems, bioregional plans, and biodiversity management plans, together with the Protected Areas Act provisions for a range of protected area options, including private or communal protected areas, give us powerful tools for achieving biodiversity management and conservation in production landscapes.

Biodiversity indicators

The NSBA provides a valuable set of indicators, such as ecosystem status and protection levels of ecosystems, that can feed into State of Environment Reports, and into Environmental Management Plans (EMPs) and Environmental Implementation Plans (EIPs) required in terms of the National Environmental Management Act (107 of 1998). The spatial products of the NSBA provide useful pointers to biodiversity priorities that should be addressed in EMPs and EIPs, as well as indicators to measure progress. In this regard, the NSBA is a useful tool for co-operative governance, helping to align the efforts of a range of departments and agencies by providing clear targets, priorities and indicators.

International policies and commitments

The NSBA also relates to South Africa's international policies and commitments. As discussed in Section 1, the NSBA contributes to

our obligations in terms of the CBD. Further, the protection and sustainable management of biodiversity is central to achieving the Millennium Development Goals (MDGs), a set of measurable, time-bound goals and targets adopted by world leaders at the UN Millennium Summit in September 2000.[16] One of the MDGs (MDG 7, on ensuring environmental sustainability) deals explicitly with biodiversity. However, wise use of biological resources is important for the full range of development priorities encompassed by all eight MDGs.

For example, eradicating hunger (MDG 1) depends on sustainable and productive agriculture, which in turn relies on conserving and maintaining agricultural soils, water, genetic resources and ecological processes. The capacity of fisheries to supply hundreds of millions of the world's people with the bulk of their animal protein intake depends on the maintenance of ecosystems (such as mangroves and coral reefs) that provide fish with habitat and sustenance.

MDGs aimed at improving health and sanitation (MDGs 4, 5 and 6) require healthy, functioning freshwater ecosystems to provide adequate supplies of clean water; and genetic resources for both modern and traditional medicines. The burden of water and fuel collection is lessened by keeping ecosystems intact and healthy; and this in turn contributes to achieving MDG 3 on gender equality and empowerment of women, who are primarily responsible for these tasks.

Similarly, the NSBA is relevant to many of the targets in the Plan of Implementation that came out of the 2002 World Summit on Sustainable Development in Johannesburg.

6. Terrestrial biodiversity assessment

Current spatial patterns

South Africa has well-developed spatial information on ecosystems and species in the terrestrial environment, relative to other countries and relative to the freshwater and marine environments in South Africa. Our spatial information on land use is less well developed.

Ecosystems can be defined in many ways, at different spatial scales. We used SANBI's recently published vegetation map of South Africa, Lesotho and Swaziland to provide the units for terrestrial ecosystems, because this gives us a consistent

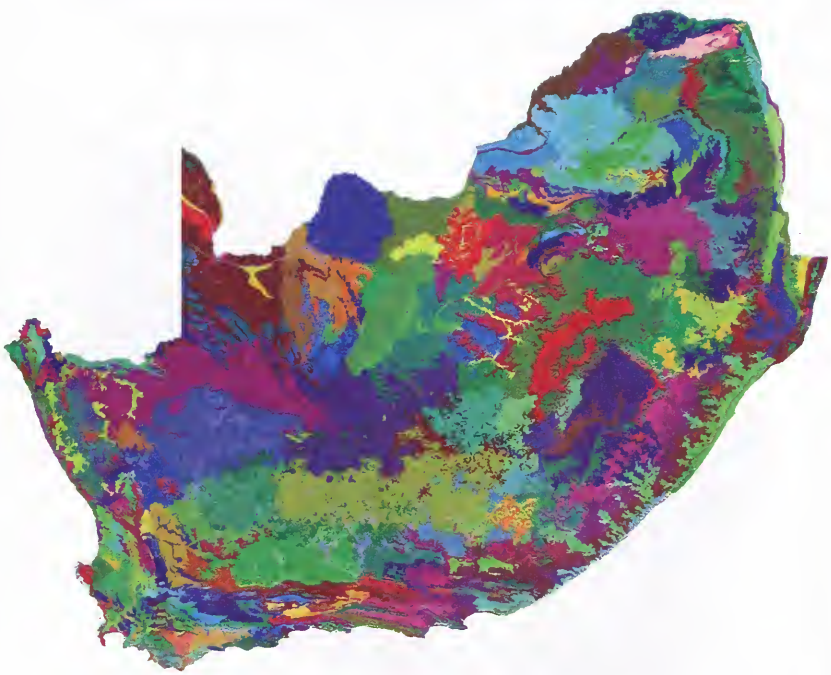


Figure 1: The SANBI 2004 vegetation map for South Africa, Lesotho and Swaziland. Of the 441 vegetation types, 440 occur in South Africa.

[16]For more information see www.undp.org/biodiversity.

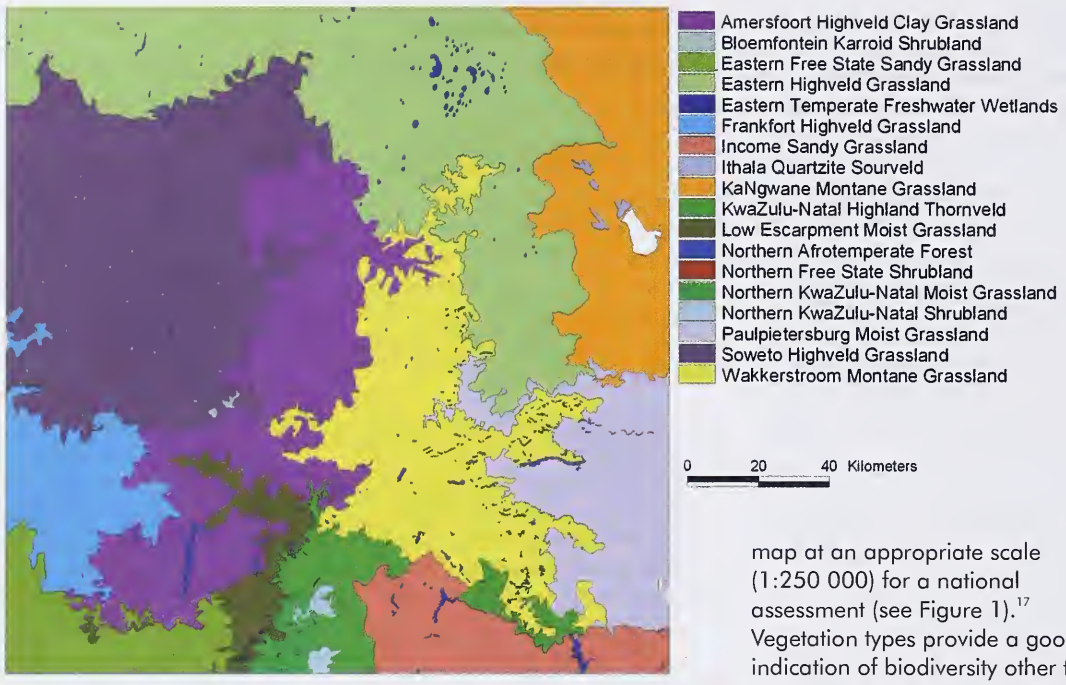


Figure 2: A close-up of the SANBI vegetation map, in the northern KwaZulu-Natal area. Note that the vegetation map includes wetland vegetation types (shown in bright blue).

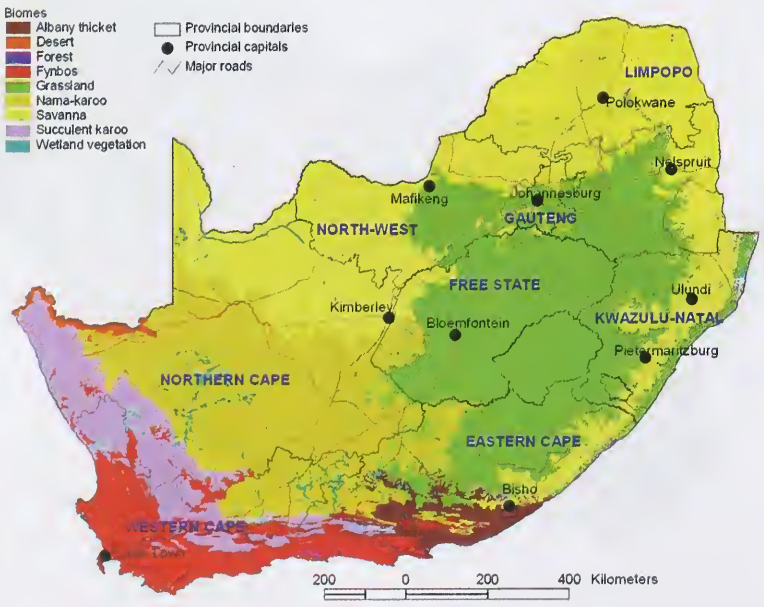


Figure 3: Biomes in South Africa, Lesotho and Swaziland.

map at an appropriate scale (1:250 000) for a national assessment (see Figure 1).[17] Vegetation types provide a good indication of biodiversity other than plant species, because most animals, birds, insects and other organisms are associated with particular vegetation types. Figure 2 zooms in on a small portion of the vegetation map, to show how detailed it is. Note that the vegetation map includes wetland vegetation types.

Vegetation types can be grouped into biomes (see Figure 3), based on shared ecological and climatic characteristics. South Africa has nine biomes according to the SANBI vegetation map: Albany thicket, desert, forest, fynbos, grassland, Nama-karoo, savanna, succulent karoo, and wetland vegetation. Some biomes have a richer array of vegetation types than others, with the fynbos biome being the richest (see Figure 4).

South Africa is abundantly rich in both plant and animal species. Because of the huge numbers

[17]We used the beta 4.0 version of the map. The final (alpha) version was not available at the time of writing, but contains changes to the boundaries of a small proportion of vegetation types. Almost all of Lesotho and Swaziland's vegetation types are shared with South Africa, highlighting the need for a co-operative approach to managing biodiversity across these political boundaries.

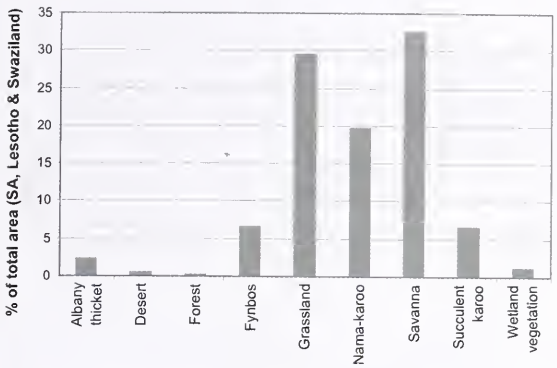


Figure 4: Percentage area and number of vegetation types per biome (the number of vegetation types is shown at the top of each bar).

involved, we decided to focus only on **endemic species** (species found only in South Africa) and **threatened species** (species in danger of extinction). We refer to these two categories jointly as **species of special concern**.

There is no single database of species locations for the whole country, so we were not able to map every single species. For plants, we used SANBI's PRECIS database, which includes approximately 24 000 plant species, of which more than 10 000 are endemic to South Africa, and more than 2 000 are threatened. For animals, we were able to include information on mammals, birds, amphibians (frogs and toads), butterflies, scorpions, and dung beetles (scarabs). Figure 5 shows the number of endemic plant species per province, and the number of threatened and rare plant species per province.[18] Figure 6 shows the number of endemic and threatened animal species per province, for the six groups of animals listed above. (Note that these are species endemic to South

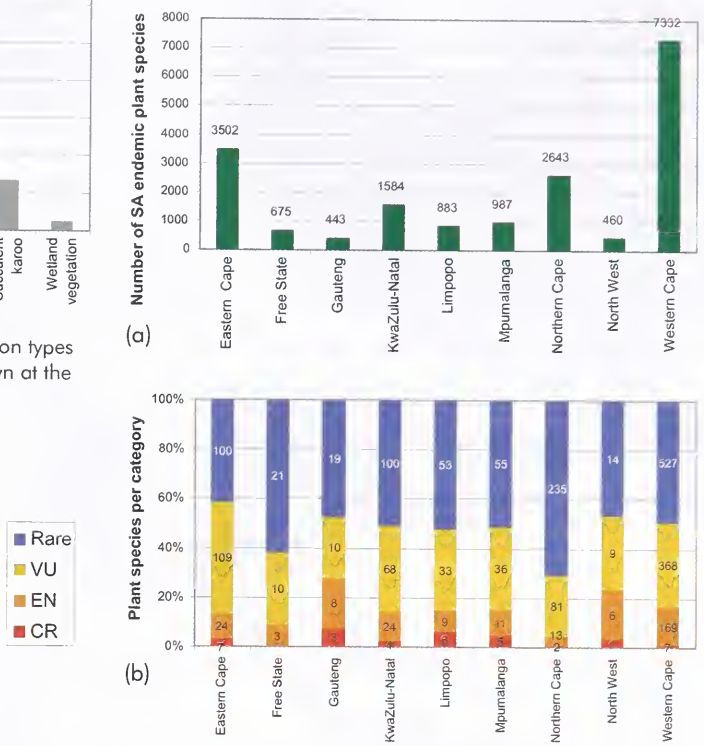


Figure 5: (a) Number of South African endemic plant species per province, and (b) number of threatened and rare plant species per province.

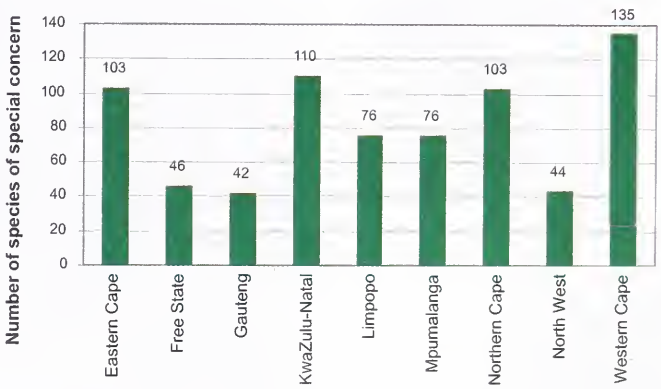


Figure 6: Number of animal species of special concern (South African endemics and threatened species) per province, for selected taxa (mammals, birds, amphibians, butterflies, scorpions, scarabs).

[18]These figures are based on information from national databases. Some provinces have more detailed and accurate provincial data available, and may have different figures. For example, Gauteng has eight critically endangered, eight endangered, and six vulnerable plant species according to provincial records, rather than the three, eight and ten reported here. Where better provincial information is available, it should take precedence over these figures. However, for consistency we have reported the figures based on national data here, for all provinces.

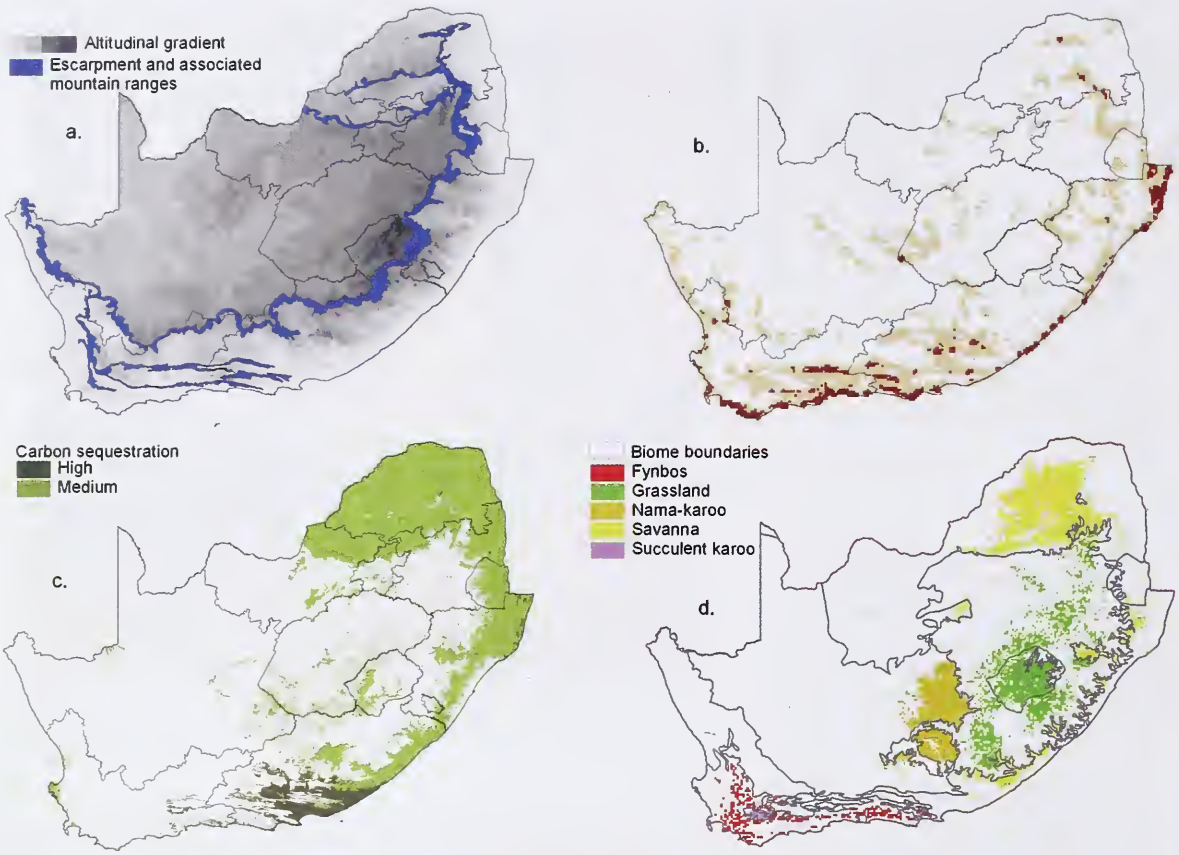


Figure 7: National-scale ecological processes, represented by (a) the Great Escarpment and associated mountain ranges, (b) biogeographic nodes, (c) carbon sequestration areas, and (d) areas of biome resilience to climate change.

Africa as a whole, not necessarily to the province. One species might occur in more than one province.)

As explained in Section 3, when assessing biodiversity it is important to consider not just biodiversity pattern (habitats and species), but also the ecological processes that allow these biodiversity patterns to persist over time. Ecological processes are often difficult to map, because they occur across space and time. Nevertheless, we were able to map and include in the NSBA several spatial features linked to ecological processes, shown in Figure 7.

Carbon sequestration (natural storage of carbon in plant biomass) is an important counteracting force to human-induced climate change, one of the biggest threats to the persistence of biodiversity. Biogeographic nodes are areas where many different vegetation types come together, creating zones of ecologically important interactions. Areas of biome resilience to climate change are areas where the current biome may persist in the face of climate change, under different climate change scenarios. The Great Escarpment is a key topographic feature of the South African landscape, associated with altitudinal and climatic gradients, and migration routes. Water production is another vital ecological process—this is discussed in Section 7.

There are many additional ecological processes that take place at the regional or local scale, represented by, for example, upland-lowland links, migration and dispersal corridors, sand movement corridors, and interfaces between different soil types. We have not attempted to include these, because the NSBA is a national-scale assessment. It is recommended that a series of additional spatial components of ecological processes should be included in assessments at the subnational scale, as was done in, for example, C.A.P. E., SKEP and STEP.

Current patterns of land use have a great impact on the health and functioning of ecosystems, so it is important to map land use in addition to the biodiversity features themselves. Loss of natural habitat is the biggest single cause of biodiversity loss in terrestrial ecosystems. The most recent available national map showing different types of land use is the 1996 National Land Cover, produced by the Council for Scientific and Industrial Research and the Agricultural Research Council. Some of the National Land Cover categories (cultivated lands, plantations, urban areas, and mines and quarries) represent areas where natural habitat has been irreversibly lost—these, shown in Figure 8, were used to quantify loss of natural habitat for this assessment.

Ideally we would like to be able to quantify and map degradation of natural habitat, in addition to outright loss of natural habitat. However, an adequate national coverage on habitat degradation is not available, so we have not been able to take degradation into account in the terrestrial component.

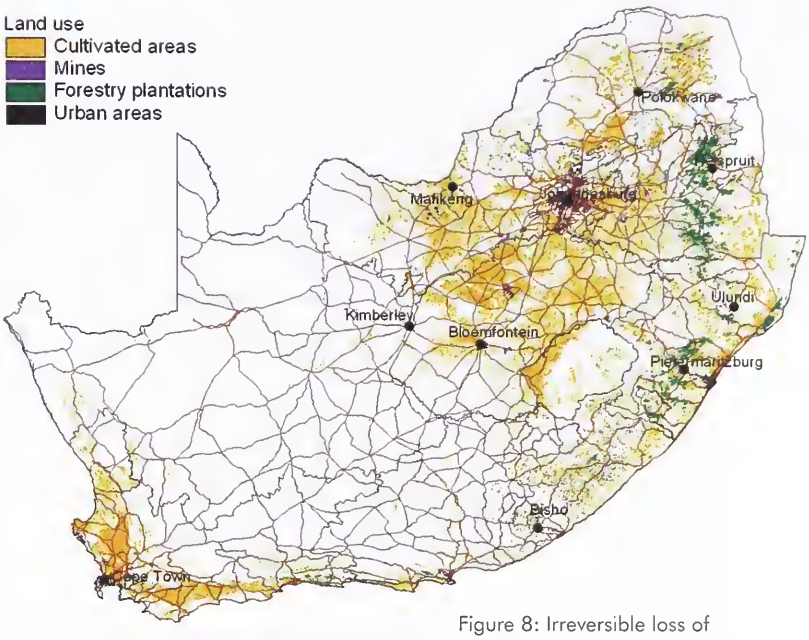


Figure 8: Irreversible loss of natural habitat in terrestrial ecosystems, based on the 1996 National Land Cover.

We hope to address this in future revisions of the NSBA.

Results of the assessment

We assessed the status of terrestrial ecosystems, using the SANBI vegetation map (Figure 1) and irreversible loss of natural habitat based on the 1996 National Land Cover (Figure 8). Box 4 explains how ecosystem status is determined. The results, shown in Figure 9, show how intact and well functioning our ecosystems are. Least threatened ecosystems are still largely intact; vulnerable ecosystems are reasonably intact, but are nearing the threshold beyond which they will start to lose ecosystem functioning; endangered ecosystems have lost significant amounts of their natural habitat, impairing their functioning; critically endangered ecosystems have so little natural habitat left that not only has their functioning been severely impaired, but species associated with the ecosystem are also being lost.

Box 4: How is ecosystem status determined?

As mentioned in Section 3, the single biggest cause of loss of biodiversity in South Africa, and in most of the world, is loss or degradation of natural habitat and ecosystems. As natural habitat is lost or degraded in an ecosystem, its functioning is increasingly compromised, leading eventually to the collapse of the ecosystem and its associated ecosystem services, and to loss of species associated with that ecosystem.

Ecosystem status is therefore based on how much of an ecosystem's original area remains intact, relative to three different thresholds. The thresholds are shown in the diagram, and are based on best available science. Note that the threshold beyond which an ecosystem becomes critically endangered varies from 16% to 36%,[19] depending on the ecosystem. The more species-rich the ecosystem, the higher the threshold. This threshold is also known as the biodiversity target: it represents the proportion of each ecosystem one would ideally like to see included in a formal protected area.

The thresholds shown in the diagram apply to terrestrial ecosystems. The same principle and method was used to determine the status of river, estuarine and marine ecosystems, but the thresholds were adapted to those ecosystems.

*biodiversity target

[19]Except for indigenous forest ecosystems, for which targets range from 30% to 100%. The DWAF Forest Conservation Plan (2004) provides a more detailed assessment of indigenous forest vegetation types, at a finer scale than the NSBA. See Berliner, D.D. & Benn, G. 2004. *Forest Conservation Plan*, prepared for DWAF-DfID Water and Forestry Support Programme. Eco-logic Consulting and GISCO, Cape Town.

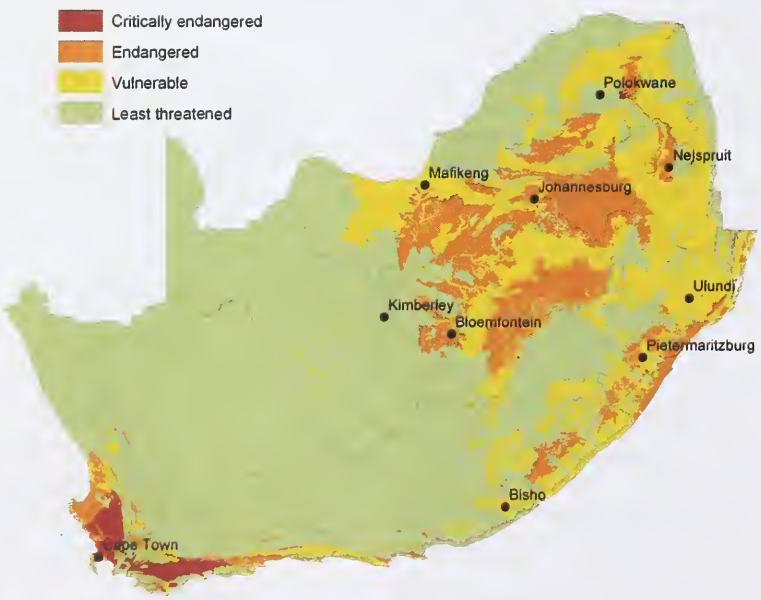


Figure 9: Status of terrestrial ecosystems.

Because the assessment of terrestrial ecosystem status is based on the 1996 National Land Cover, we know it is out of date. Since 1996, significant further loss of natural habitat has taken place, especially in some parts of the country such as KwaZulu-Natal. It is likely that more terrestrial ecosystems have become threatened since 1996, so this should be seen as a conservative assessment. Although the NSBA is based on the best available national data, finer-scale biodiversity assessments at the regional or local level based on more detailed and up-to-date information may identify additional threatened ecosystems.

Some of the key results are shown in Figure 10 and Figure 11. Thirty-four

percent of terrestrial ecosystems are threatened. Of these:

- 21 terrestrial ecosystems (5%) are critically endangered. Fourteen of these are in the fynbos biome, five are in the forest biome, one is in the grassland biome, and one is a wetland vegetation type.
- 58 terrestrial ecosystems (13%) are endangered. Most are in the grassland and savanna biomes.
- 70 terrestrial ecosystems (16%) are vulnerable. Most are in the fynbos and grassland biomes.

We also assessed the **protection levels of terrestrial ecosystems**, to find out how well the protected area network is performing in terms of representing terrestrial biodiversity.

Prior to the NSBA, there was no complete map of all the protected areas in South Africa, so the first step was to gather information from the provinces, SANParks and DEAT to compile such a map, shown in Figure 12. There are many different types of protected areas, so it is helpful to group them into a few main types. Type 1 protected areas include National Parks, Provincial Nature Reserves, Local Authority Nature Reserves and DWAF Forest Nature Reserves. Type 2 protected areas include Mountain Catchment Areas, Wildlife Management Areas, private nature reserves, National Heritage Sites, DWAF Forest Areas, SANDF property, bird sanctuaries, and botanical gardens. Type 3 protected areas include game farms, private game reserves and conservancies. They are completely informal and do not provide secure long-term protection for biodiversity. Only a few protected areas are larger than 100 000 ha, most of them being 1 000–10 000 ha in size.

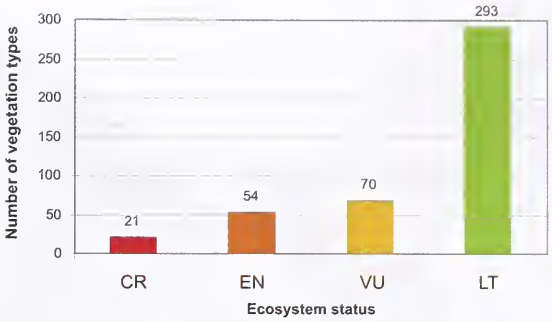


Figure 10: Number of terrestrial ecosystems per status category (CR = critically endangered, EN = endangered, VU = vulnerable, LT = least threatened).

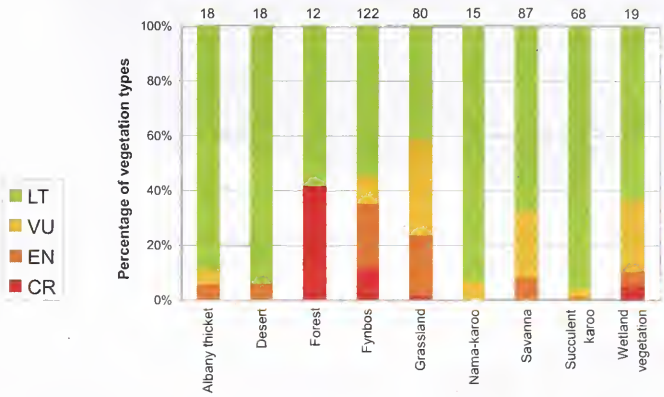


Figure 11: Status of terrestrial ecosystems by biome (the number of vegetation types per biome is shown at the top of each bar).

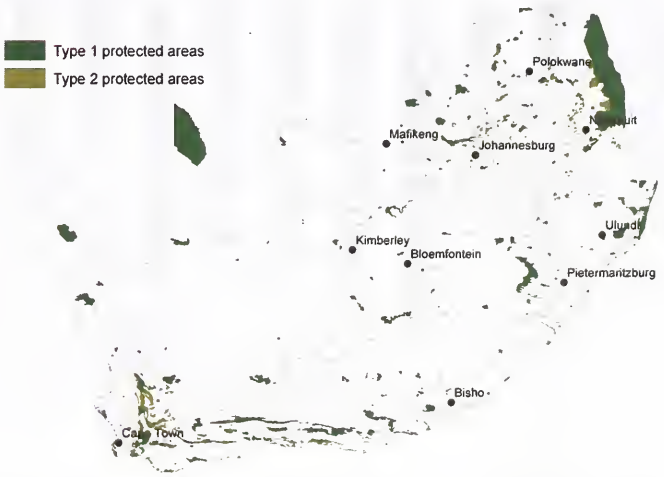


Figure 12: Protected areas in South Africa. Type 1 protected areas include national parks and provincial nature reserves, and have a more secure legal status than Type 2 protected areas.

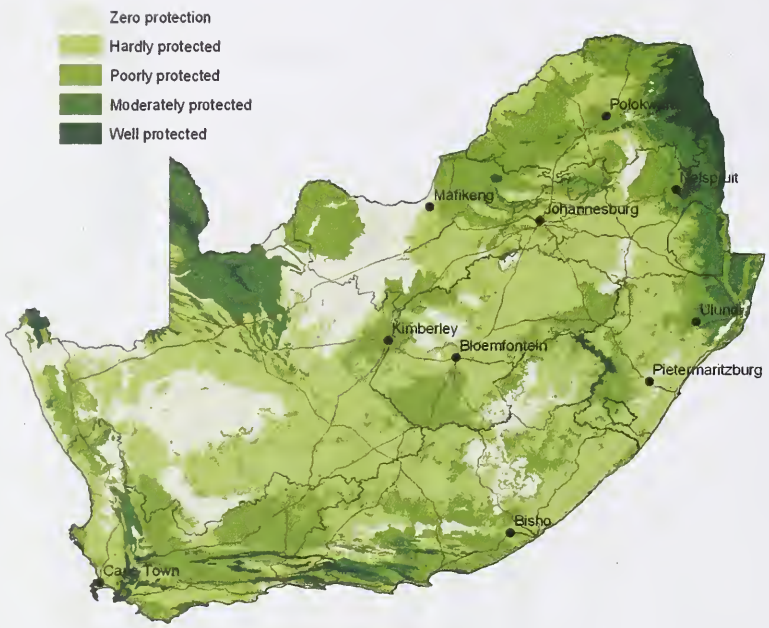


Figure 13: Protection levels of terrestrial ecosystems, based on the proportion of the biodiversity target met in a Type 1 protected area.

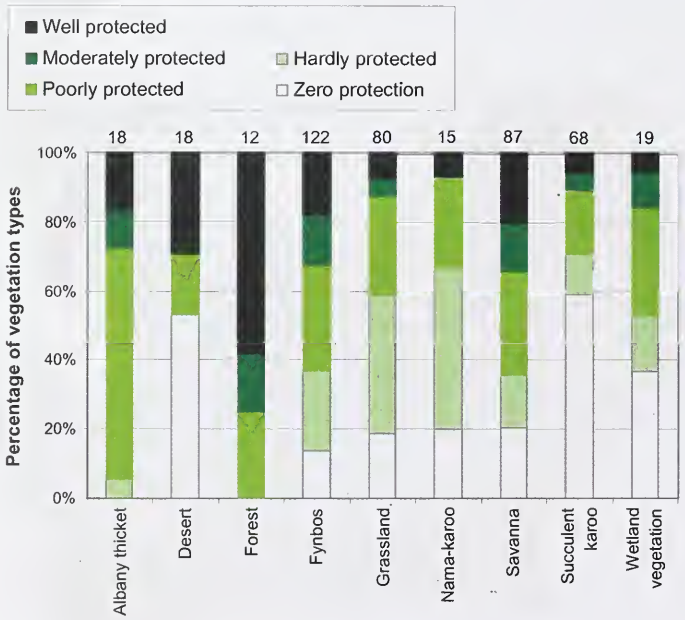


Figure 14: Protection levels of terrestrial ecosystems by biome (the number of vegetation types per biome is shown at the top of each bar).

Some of the first protected areas in the world were established here in the late 1800s. However, the earliest approaches to planning were typically *ad hoc* and most protected areas were located in landscapes of low economic potential. South Africa's protected area network (and those of other countries) was not designed to conserve a representative sample of biodiversity, so it is not surprising that nearly half of the country's terrestrial ecosystems have no or extremely low levels of formal protection, as shown in Figure 13.

The total percentage of South Africa's land area in Type 1 and 2 protected areas is nearly 6%. However, the percentage of well protected ecosystems is higher, at 15%. Most of these well protected ecosystems are in the fynbos mountains and the savanna biome, while the most severely under-protected ecosystems tend to be in the succulent karoo, the grasslands, and the fynbos lowlands.[20]

In expanding our protected area network, it makes sense to focus on biomes and ecosystems that are currently under-protected, to bring us closer to the ideal of a representative sample of all ecosystems in protected areas.

Because species distribution data are on the whole available only at a very broad scale, it was not possible to look at the numbers of species represented in protected areas. However, we were able to analyse **important species areas** at the scale of quarter degree squares (QDS). Figure 15 shows the combined results for plant and animal species. A high score indicates an area that has either many species of special concern or at least one species of

[20] A well protected ecosystem has its full biodiversity target met in a Type 1 protected area. A moderately protected ecosystem has more than half of its biodiversity target met in the Type 1 protected area, poorly protected ecosystems have between five percent and half of their biodiversity target met in a Type 1 protected area, and hardly protected ecosystems have less than five percent of their target met in a Type 1 protected area. Ecosystems with zero protection are not included in any Type 1 protected areas.

special concern found nowhere else. Regions with high species scores are located mainly along the coastal regions, with particularly high concentrations in the Cape Floristic Region, the Succulent Karoo, and KwaZulu-Natal. The escarpment also has a high species conservation value along its extent, all the way into the Limpopo Province.

Priorities for action

In order to identify overall geographic priority areas for conservation action, we combined the systematic analyses of species, ecosystems and ecological processes to develop overall priority scores, shown in Figure 16(a). Areas with high scores were grouped according to topography and biome boundaries, resulting in nine broad geographic priority areas for conservation action, shown in Figure 16(b).

It is important to note, firstly, that the boundaries of these priority areas are rough, not exact, and secondly, that this map does not imply that there is no important biodiversity in the rest of the country. However, given limited resources (people, time, and money), one cannot act everywhere at once, so it makes sense to focus one's actions on places where the return is likely to be greatest. These priority areas also highlight places where neighbouring provinces need to co-operate in managing significant biodiversity resources that cross provincial boundaries.

In deciding when and how to act within these priority areas, it is useful to understand the socio-economic context and likely future pressures on biodiversity. This is often best done at the local level; however, a national picture provides

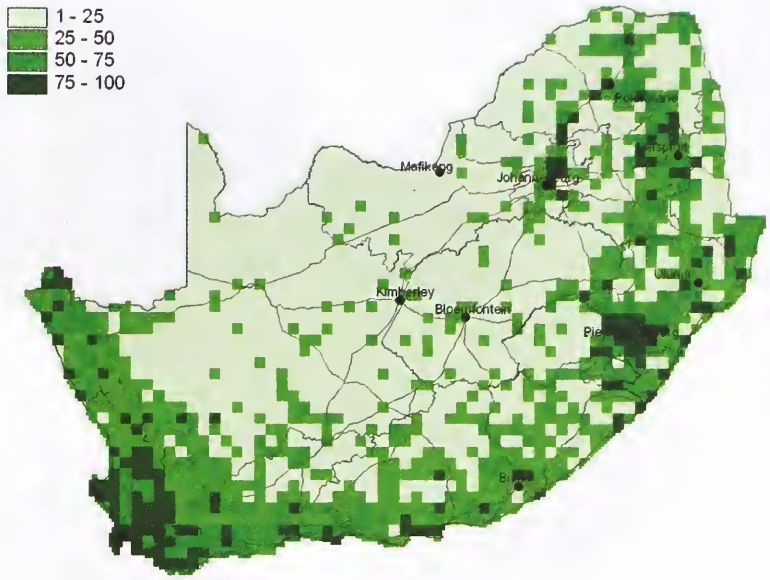


Figure 15: Species priority scores based on combined analyses for plant and animal species of special concern (threatened species and South African endemics).

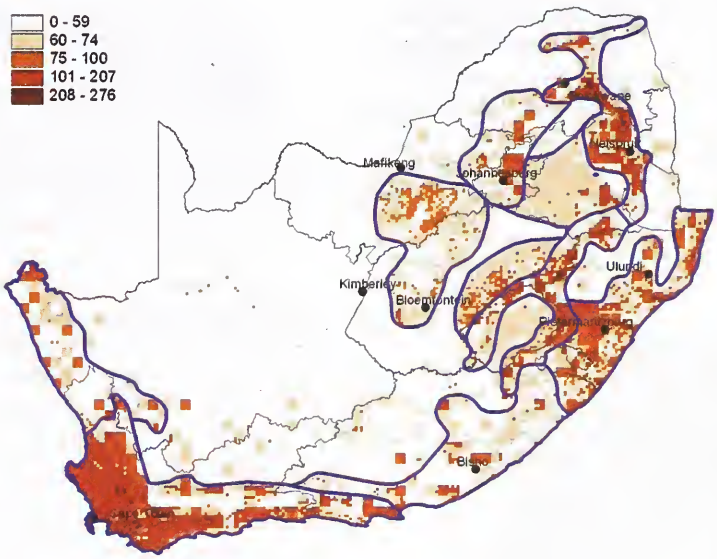


Figure 16: (a) Overall terrestrial priority scores, based on combined analyses of species, ecosystems and ecological processes.

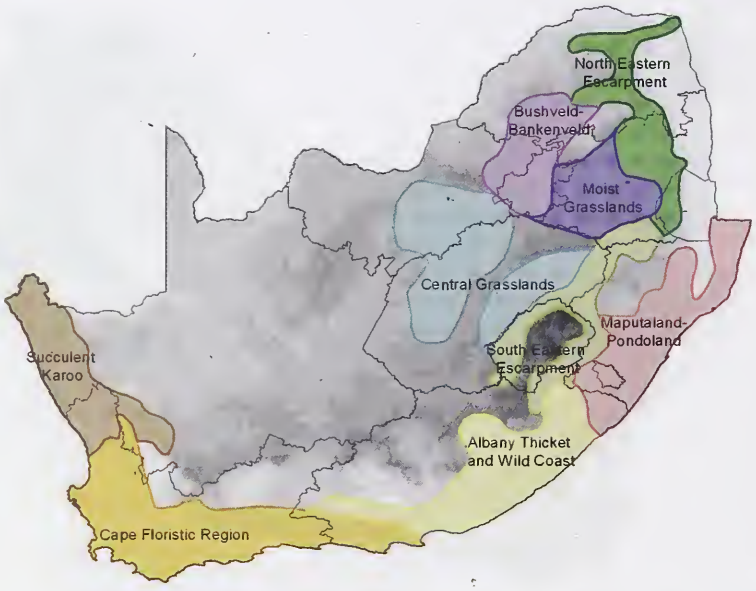


Figure 16: (b) Nine broad priority areas for conservation action, based on overall priority scores.

Future pressure ranking

highest
1 Moist Grasslands
2 Maputaland-Pondoland
3 Bushveld-Bankenveld
4 Central Grasslands
5 North Eastern Escarpment
6 Albany Thicket and Wild Coast
7 South Eastern Escarpment
8 Cape Floristic Region
lowest 9 Succulent Karoo

Figure 16: (c) Ranking of priority areas according to combined level of future pressures on biodiversity in each (see Figure 17) (1 = highest, 9 = lowest).

a useful starting point. We looked at four factors that increase pressure for conversion of natural habitat to other land uses: suitability of land for crop agriculture, suitability of land for afforestation, mining potential, and increases in population density signalling likely urban expansion. We also looked at two factors that increase the likelihood that remaining natural habitat will become degraded: invasion of alien plants, and degree of fragmentation of natural habitat. These six factors are shown in Figure 17. They are not evenly distributed throughout the landscape. For example, crop potential is a greater pressure on biodiversity in grasslands priority areas, while afforestation is of greater concern in the Maputaland Pondoland priority area. This starts to give clues about the kind of industry engagement and management approach that is required to conserve biodiversity in different priority areas.

Ranking of the nine priority areas according to the combined level of future pressures on biodiversity in each—shown in the blocks in Figure 16(c)—indicates that the moist grasslands, Bushveld-Bankenveld, Maputaland Pondoland and central grasslands priority areas face the highest overall pressures.[21] It is worth noting that pressures on biodiversity seem to be highest in the northern and eastern parts of the country, while our established bioregional programmes are mainly in the southern parts of the country. This analysis confirms the urgency of the National Grasslands Initiative and highlights the need to consider establishing additional bioregional programmes.

Five inter-linked sets of actions to conserve terrestrial biodiversity in priority areas are suggested:

1. Work with production sectors that are major land users (such as agriculture, infrastructure and property development, forestry and mining), to develop and implement sector-specific wise-practice guidelines to minimise loss of natural habitat and species in threatened ecosystems, and to protect ecosystem functioning. For example, in the Cape Floristic Region the wine industry has

[21] Because this analysis is broad-scale, it does not preclude the existence of intense pressures on biodiversity in particular local areas within each of the priority areas, even those that fall at the lower end of the combined overall pressure ranking.

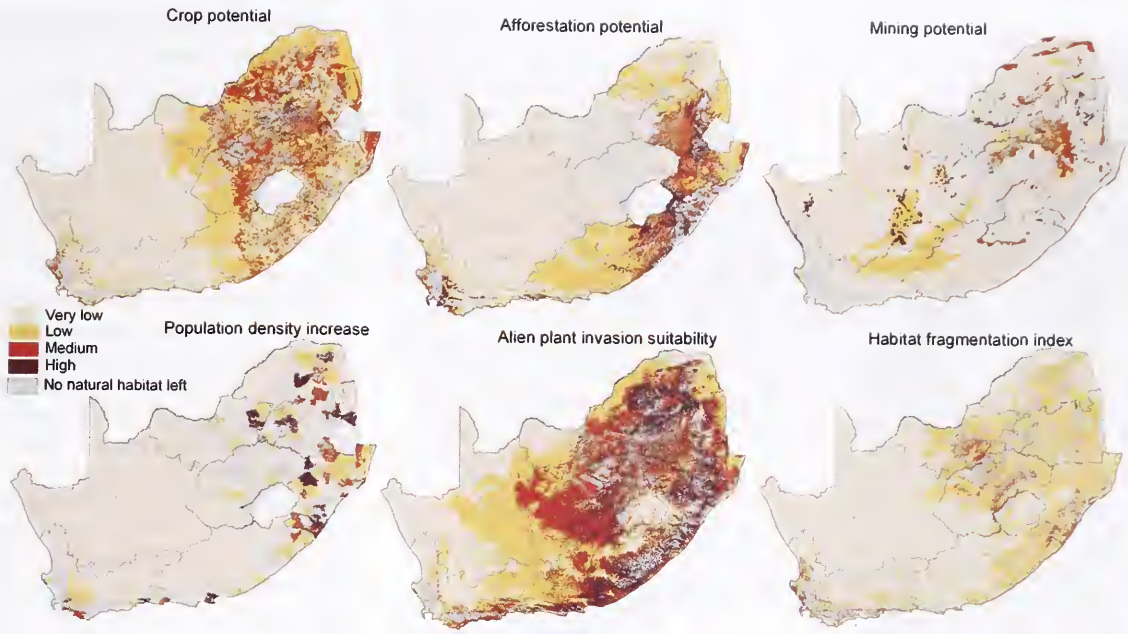


Figure 17: Future pressures on terrestrial biodiversity.

incorporated biodiversity criteria and guidelines in its Integrated Production of Wine guidelines, through the Biodiversity and Wine Initiative, led by the industry in partnership with conservation NGOs.

2. Strengthen bioregional programmes. As explained briefly in Section 4, bioregional programmes are multisectoral programmes that provide a framework for collaborative conservation action, often across administrative or political boundaries. Existing bioregional programmes are C.A.P. E., STEP, SKEP and the Maloti-Drakensberg Transfrontier Project; emerging ones include the Wild Coast Conservation and Sustainable Development Project and the National Grasslands Initiative. Bioregional programmes can include fine-scale biodiversity planning initiatives in local areas of particular concern, for example where biodiversity is under great pressure and/or where few options remain for meeting biodiversity targets. It is vital that the products that emerge from such fine-scale biodiversity plans are appropriate and useful for local-level decision-making by municipalities and other land-use decision-makers, such as the Department of Agriculture and provincial environmental affairs departments. Local and district municipalities should be seen as key stakeholders in bioregional programmes.

3. Minimise loss of habitat in threatened ecosystems. This can be achieved through at least two mechanisms:

   a. By promoting stewardship among private and communal landowners. This involves increasing the capacity of

Photo Philip Desmet

provincial conservation agencies to work outside protected areas, with a range of landowners and land users. Indeed, it often requires a review of the strategic direction of these organisations, and a shift from seeing extension positions as entry-level positions to seeing extension work as specialised and highly skilled. Stewardship involves wise management of land, including, for example, sustainable grazing practices, clearing invasive alien species, conserving wetland areas, and not ploughing last remaining fragments of natural habitat in critically endangered ecosystems.

b. By using regulations in terms of the Biodiversity Act to restrict certain land uses in listed threatened ecosystems (see Section 5).

4. Prevent and manage the spread of invasive alien species, by focusing alien clearing efforts, such as Working for Water, on areas where socio-economic needs (e.g. water production and poverty alleviation) coincide with areas of high biodiversity priority.

5. Expand formal protected areas to achieve biodiversity targets, in consultation with implementing agencies such as SANParks and provincial conservation agencies. The information provided by the NSBA, including biodiversity targets for vegetation types and the analysis of current protection levels in relation to these targets, is one factor that should guide protected area expansion. We recognise fully that there are other, often management-related, factors involved (such as economies of scale and efficiencies in the configuration of protected areas).

How this assessment can be improved

As explained above, our assessment of the status of terrestrial ecosystems is based on estimates of loss of natural habitat from the 1996 National Land Cover, and must therefore be seen as a conservative assessment. As soon as the 2000 National Land Cover becomes available, SANBI will re-do the assessment and publish the new results. However, by the time the 2000 National Land Cover is available it will already be several years out of date. **There is an urgent need for up-to-date, country-wide information on loss and degradation of natural habitat.** The lack of this information, together with similar information for the freshwater and marine environments, is by far the biggest limiting factor in the NSBA.

A second gap is **spatial information on the economic value of natural resources**, including ecosystem services, highlighting biodiversity features of especially high value such as wetlands. For terrestrial biodiversity, a national list of useful species and other directly consumed components of biodiversity, together with data on their location, would strengthen the NSBA.

A third gap is **spatial information on the cultural value of natural resources**. This may be best included in biodiversity plans at the regional or local scale, rather than the national scale. However, it is highlighted here because such information is important for making links between biodiversity and other aspects of the socio-economy.

A fourth gap is **phytosociological data for vegetation types**.[22] Only a

[22] This means data about the species composition of a vegetation type, or plant communities associated with a vegetation type.

third of the vegetation types used for this assessment have adequate phytosociological data. There is a need for a national protocol and set of guidelines for gathering new data, so that future surveys contribute to filling the geographic data gaps and conform to a minimum set of standards.

A fifth gap is point locality data for species of special concern, particularly threatened species. Our ability to include species meaningfully in the analysis was limited by the broad scale of most of the available species data and by incomplete data sets.

7. River biodiversity assessment

Current spatial patterns

The river component of the NSBA is based on the work of the DWAF-CSIR-WRC National Freshwater Biodiversity Initiative, and is the first ever systematic assessment of river biodiversity in South Africa.[23]

The National Freshwater Biodiversity Initiative developed a new way of mapping river biodiversity, using river heterogeneity signatures. The signatures are based on geomorphology (the nature of the landscape through which a river flows) and hydrology (the amount of water flow in a river, and how variable the flow is). Figure 18 shows the resulting 120 river signatures. These should be seen as preliminary, and are likely to be refined. Rivers that share the same signature are regarded as sharing similar biodiversity.

River ecosystems, in addition to being home to large numbers of fish and other species, are crucial for the production of the country's water supply. Together with wetlands, they play a key role in purifying and delivering the water on which our economy and quality of life depend. Well functioning, intact river and wetland ecosystems are also crucial for flood control.

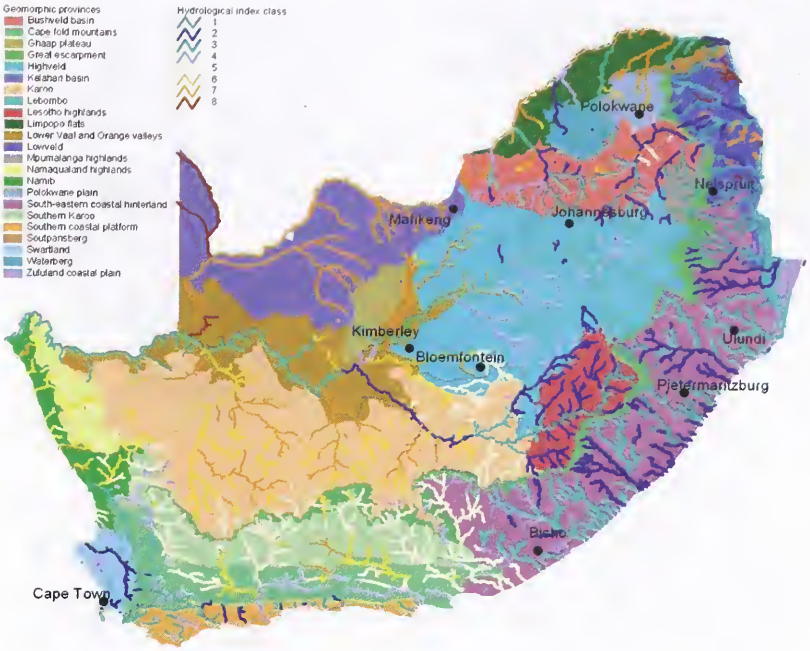


Figure 18: River heterogeneity signatures for South Africa, Lesotho and Swaziland. Unique combinations of geomorphic provinces and hydrological index represent unique signatures.

The state of river ecosystems depends not only on what happens in rivers themselves and on their banks, but also on how land is managed throughout whole catchments. Figure 19 shows the top ten percent of tertiary and quaternary catchments in South Africa (in terms of Mean Annual Run-off), which jointly yield fifty percent of the country's water. Many of them occur along the escarpment and in other mountainous areas. It is especially important that the use and management of land in these catchments does not compromise our water production infrastructure, for example through stripping of natural vegetation for forestry or crops or through overgrazing in critical catchment areas.

[23] For more on this ongoing initiative see www.csir.co.za/rivercons. The first phase is due to be completed in 2005, and the results presented here should be seen as work in progress (DWAF = Department of Water Affairs and Forestry, CSIR = Council for Scientific and Industrial Research, WRC = Water Research Commission).

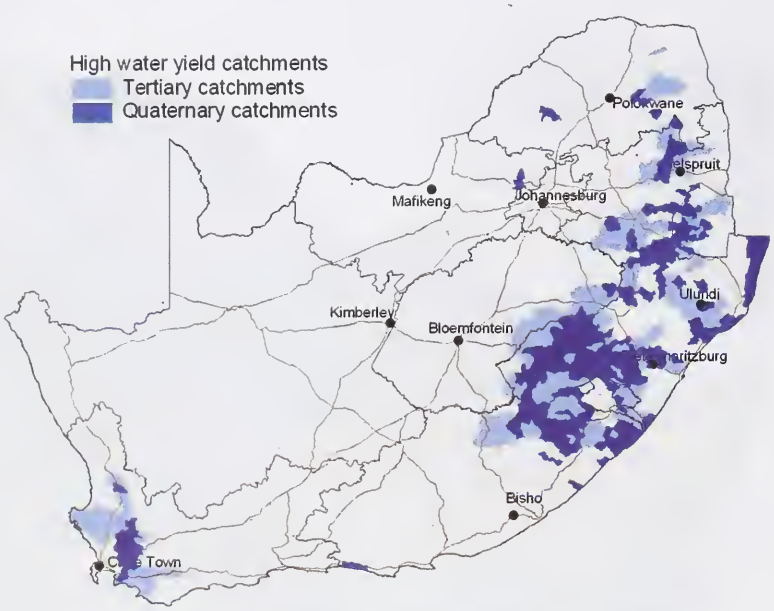


Figure 19: High water yield catchments. These quaternary catchments and tertiary catchments yield approximately 50% of the country's water supply.

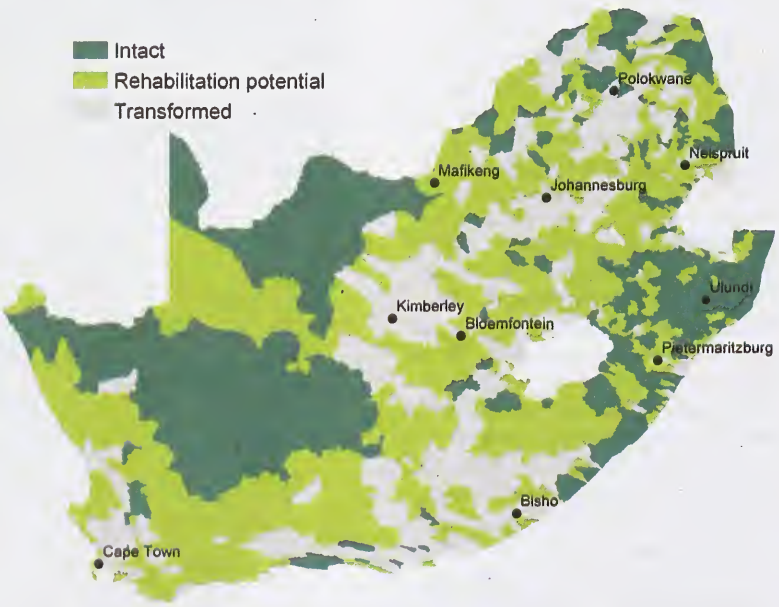


Figure 20: River integrity per quaternary catchment. Integrity assessment was based on mainstem rivers, and considered integrity of instream and riparian habitat.

In the terrestrial component we used information from the National Land Cover to assess where terrestrial biodiversity is still intact, and where it has been lost. In the river component, we used the national Water Situation Assessment Model, which assigns a present ecological status category (PESC) to each quaternary catchment, ranging from A (natural, unmodified) to F (critically modified), based on expert assessment of the integrity of river habitat.[24] Both instream habitat and riparian (river bank) habitat were considered, but only the mainstem rivers were assessed, not their tributaries. Figure 20 shows the results: 26% of quaternary catchments are intact (category A or B), 48% are moderately modified (category C) and 26% are transformed (categories D–F).

As noted in Section 1, it was not possible to undertake a full assessment of wetland ecosystems, because of lack of appropriate national data on wetlands. However, we hope to address this in future revisions of the NSBA,[25] so that the river component can be expanded to become a freshwater component. In the absence of a full national assessment of wetlands, we would like to emphasise that all wetlands play a significant ecological role, especially with respect to ensuring water quality and a consistent water supply, and special care should be taken not to disturb their functioning.

Results of the assessment

We assessed the **status of river ecosystems** based on the river signatures in Figure 18 and the

[24]Kleynhans, C.J. 2000. Desktop estimates of the ecological importance and sensitivity categories (EISC), default ecological management classes (DEMC), present ecological status categories (PESC), present attainable ecological management classes (present AEMC), and best attainable ecological management class (best AEMC) for quaternary catchments in South Africa. *DWAF report*. Institute for Water Quality Studies.

[25]In collaboration with the Working for Wetlands programme, housed in SANBI.

integrity of mainstem rivers in Figure 20.[26] The results are shown in Figure 21 and Figure 22. Of South Africa's 120 river signatures, 82% are threatened. A disturbing 44% are critically endangered, 27% are endangered, 11% are vulnerable, 18% are least threatened. A critically endangered river signature is one for which there are few remaining intact examples, thus putting the biodiversity patterns and ecological processes associated with that river signature at risk.

Comparing the status of terrestrial ecosystems with the status of river ecosystems, we see that only 5% of terrestrial ecosystems are critically endangered, while 44% of river ecosystems are critically endangered (compare Figure 21 and Figure 22 with Figure 9 and Figure 10). A third of terrestrial ecosystems are threatened, compared with 82% of river ecosystems. Our river ecosystems are in a much poorer state overall than our terrestrial ecosystems. This reflects the fact that South Africa is a water-scarce country, with multiple demands, from urban settlements, agriculture and industry, on our limited water resources. Many of the mainstem rivers are heavily utilised, and our river ecosystems are, in general, under more pressure than our terrestrial ecosystems. Water is South Africa's most critical natural resource.

For terrestrial ecosystems we assessed not only at their current status but also at their current protection levels. However, for river ecosystems, defining 'protection' is more difficult than for terrestrial ecosystems. The establishment and management of formal protected areas has usually focused on protecting terrestrial ecosystems, with little emphasis on proclaiming protected areas for the purpose of conserving entire river lengths. In any case this is not a practical management option for most rivers, which cross great distances in the landscape. A good example of this is evidenced by the Kruger National Park, South Africa's flagship national park. Rivers in the region of the Kruger National Park flow in an east-west direction, while the park spans the landscape in a north-south direction. This means that all the

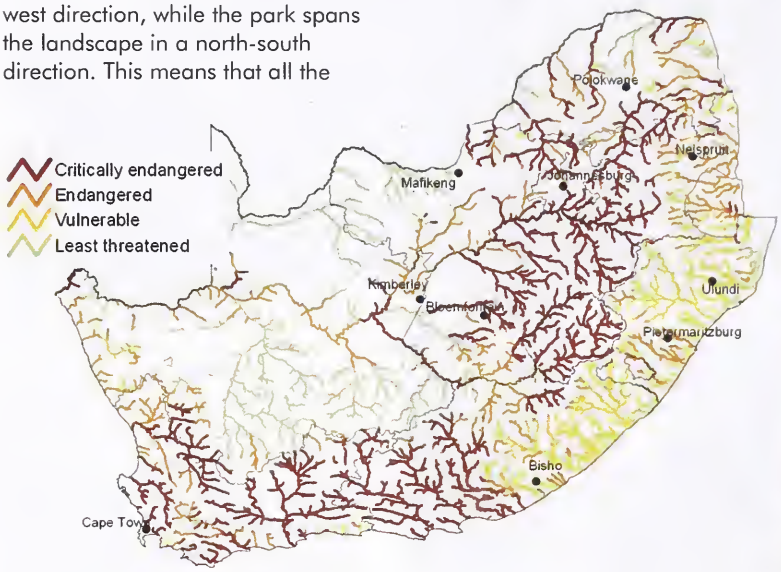


Figure 21: Status of river ecosystems (mainstems only).

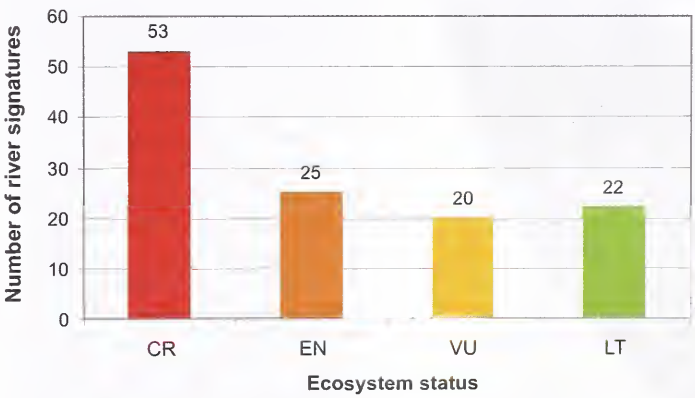


Figure 22: Number of river signatures per ecosystem status category

[26]The method used was similar to that used for terrestrial ecosystems, explained in Box 4. The calculation was based on the prapartian af the length of each river signature that remains intact. Intact river length is defined as the length of the river in natural or near-natural present ecological state. Critically endangered river signatures have less than 10% of their length intact, endangered river signatures less than 40%, and vulnerable river signatures less than 60%.

Photo Kristal Maze

major rivers flow through the park, rather than being contained within the park.

More importantly, rivers are impacted by activities that happen throughout their entire catchments, so even if a whole river length is included in a protected area, the river is subject to impacts that could originate far away. However, rivers that do flow through protected areas often show significant recovery (i.e. their health is in much better condition downstream of the protected area than upstream of the protected area). This highlights the positive impact that good land management of the surrounding landscape can have on river condition—emphasising the importance of taking an integrated resource management approach which considers the combined needs of terrestrial and freshwater biodiversity, inside and outside protected areas.

Priorities for action

Quality, quantity and sustainability of water resources are fully dependent on **good land management practices within catchments.** The fate of the country's natural water resources therefore relies on an integrated approach to managing water and land, to achieve ecological and socio-economic sustainability. Increased attention should be paid to managing rivers for meeting immediate social and economic needs as well as for maintaining their long-term functioning to meet the needs of future generations. The establishment of Catchment Management Agencies, which will develop Catchment Management Strategies, is an important step towards achieving this.

This assessment highlights Water Management Areas (WMAs) in which it may be difficult to conserve river ecosystem functioning that depends on connectivity between tributaries and their mainstems. The mainstem rivers of the Berg, Breede, Gouritz, Middle Vaal, and Upper Vaal Water Management Areas are the most severely threatened in South Africa, followed by the Olifants/Doring, Fish to Tsitsikamma, Crocodile/Marico, and Olifants. These Water Management Areas, shown in the darkest two shades of blue in Figure 23, have mainstems that have been significantly modified for human use. There are still opportunities to conserve biodiversity in healthy tributaries in these WMAs, as long as the mainstems are managed to allow for connectivity between their tributaries and basic functioning of ecological processes. The Catchments Management Strategies for these WMAs should pay particular attention to this.

The following sets of actions to conserve river biodiversity and functioning are emphasised:

1. Integrate land and water policy and management, as a basis for integrated management strategies. Since DWAF is the national custodian of inland water resources and DEAT is the national custodian of biodiversity, conservation of freshwater biodiversity cannot be successful without achieving some interface in policy and strategies between these two departments. Both national departments have undertaken rigorous policy revision during the past decade. However, their respective initiatives have mostly built on department-specific terminology, concepts and

understanding. The challenge is to find common ground for the systematic conservation of freshwater biodiversity, where the two parties can combine their skills and resources towards scientifically sound conservation designs and practically feasible implementation plans. Development of criteria for river management that address social, economic and ecological sustainability, would be one step towards achieving this.

2. Feed information from this assessment into DWAF's Water Resource Classification System and Catchment Management Strategies, to help determine how many rivers, and which rivers, need to be managed in a natural or moderately impacted state.
3. For mainstems that are heavily impacted, determine, implement and monitor ecological reserves in terms of the National Water Act (1998), to ensure that these mainstems are managed in a way that allows for connectivity between tributaries that have been identified as biodiversity priorities.
4. Integrate rivers into bioregional plans and programmes, and fine-scale biodiversity assessments. Biodiversity assessments have traditionally had a strong terrestrial bias. However, exciting early steps towards integrating terrestrial and freshwater biodiversity are being made in some regional and local plans. Lessons from these should be captured and shared.

How this assessment can be improved

River biodiversity assessment is in its early developmental stages, and the results reported here are preliminary. Some of the key limitations that need attention in the next five years to improve this assessment are as follows:

- The river assessment should be extended to become a freshwater assessment, including wetlands and groundwater.
- The river heterogeneity signatures need to be further developed, refined, and reviewed by river ecologists.
- River integrity data which accurately reflect the condition of both mainstem rivers and their tributaries, need to be developed at a national scale. It is important to bring catchment-based state-of-rivers reporting together to form a national state-of-rivers report, which can accurately reflect the condition of at least the 1:500 000 rivers in South Africa.

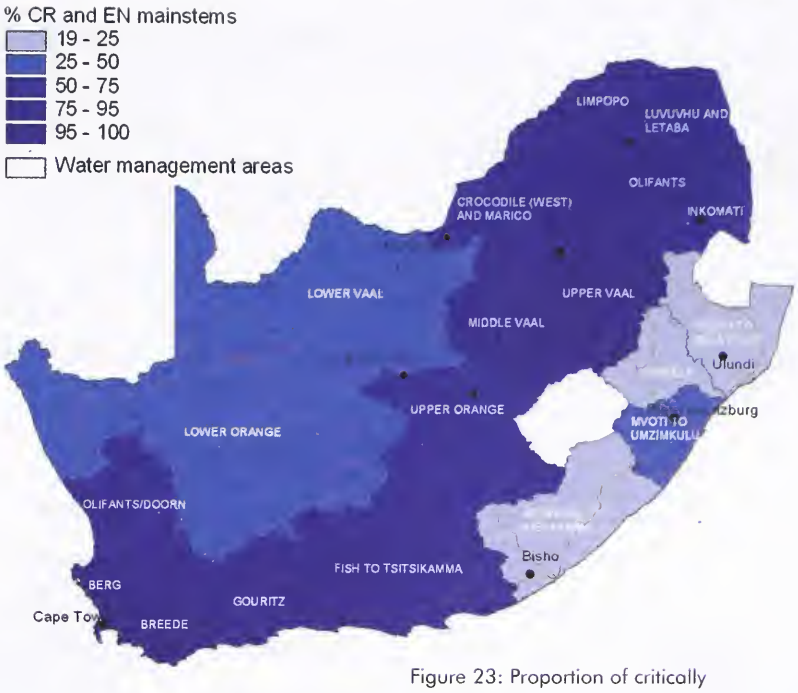


Figure 23: Proportion of critically endangered and endangered mainstems per Water Management Area (WMA).

	Cool Temperate	Warm Temperate	Subtropical
Estuarine bay		1	3
Permanently open	2	28	15
River mouth	2	6	3
Estuarine lake		4	2
Temporarily closed	7	88	98

Table 1: Estuaries can be divided into five types, which are distributed across three zones, resulting in 13 groups of estuarine ecosystems

- Key riverine processes, such as connectivity, should be incorporated in the assessment.
- Spatial information on relevant socio-economic factors, such as water-stressed catchments, should be compiled.

8. Estuarine biodiversity assessment

Current spatial patterns

Estuaries are formed where freshwater from rivers runs out to the sea. The influence of the tides and the changing mixture of freshwater and seawater make estuaries special ecosystems that are important for a range of ecological processes and ecosystem services. For example, they provide breeding areas and nurseries for marine species, including economically important fish, and they channel nutrient and sediment flows from rivers into the sea, contributing to the productivity of marine ecosystems.

South Africa has 259 estuaries. They are sparse along the west cost, increasing in density as one moves eastwards. This reflects the fact that the western part of the country is arid, with relatively few rivers, while the eastern part is wetter, with more rivers.

The value of estuarine fisheries and the contribution of estuaries to marine fisheries in South Africa was recently estimated to be R923 million (nearly a billion Rand) per year—an average of R3.6 million per estuary.[27]

Estuaries can be divided into five different types: estuarine bays, permanently open estuaries, river mouths, estuarine lakes, and temporarily closed estuaries. These estuary types are distributed across three zones: the cool temperate zone (on the west coast), the warm temperate zone (on the south coast), and the subtropical zone (on the east coast) (see Figure 24), giving us 13 estuarine zonal-types, or **13 groups of estuaries** (see Table 1). Each of these groups can be considered a broad estuarine ecosystem type.

The health of all estuaries was rated by estuary experts in 2000 as excellent (in near pristine condition, negligible human impact), good (no major negative human-related influences on either the estuary or the catchment), fair (noticeable degree of ecological degradation in the catchment and/or estuary, moderate impact), or poor (major ecological degradation arising from a combination of human-related influences, high impact).[28] Overall, 62% of South Africa's estuaries are in good or excellent condition.

Pressures on estuaries come from two main sources: activities that occur within and immediately around them (direct pressures), and from activities that reduce the flow of freshwater into estuaries (pressures on freshwater inputs).

[27] Lomberth, S.J. & Turpie, J.K. 2003. The role of estuaries in South African fisheries: economic importance and economic implications. *African Journal of Marine Science* 25: 131–157. This value is given in 1997 rands.

[28] Based on Whitfield's (2000) assessment of the condition of estuaries. Whitfield, A.K. 2000. *Available scientific information on individual estuarine systems*. WRC Report no. 577/3/00.

Direct pressures on estuaries include:

- Loss or alteration of natural estuary habitat (for example due to the construction of marinas and jetties).
- Changes in mouth dynamics, such as the manipulation of mouths to maintain constant water levels or prevent flooding of holiday homes.
- Over-exploitation of estuarine resources such as fish.
- Sedimentation of estuaries due to poor catchment or mouth management.
- Recreational disturbance.
- Pollution, for example release of sewage into Knysna estuary.

Pressures on freshwater inputs include:

- Reductions in freshwater inputs due to upstream abstraction or afforestation.

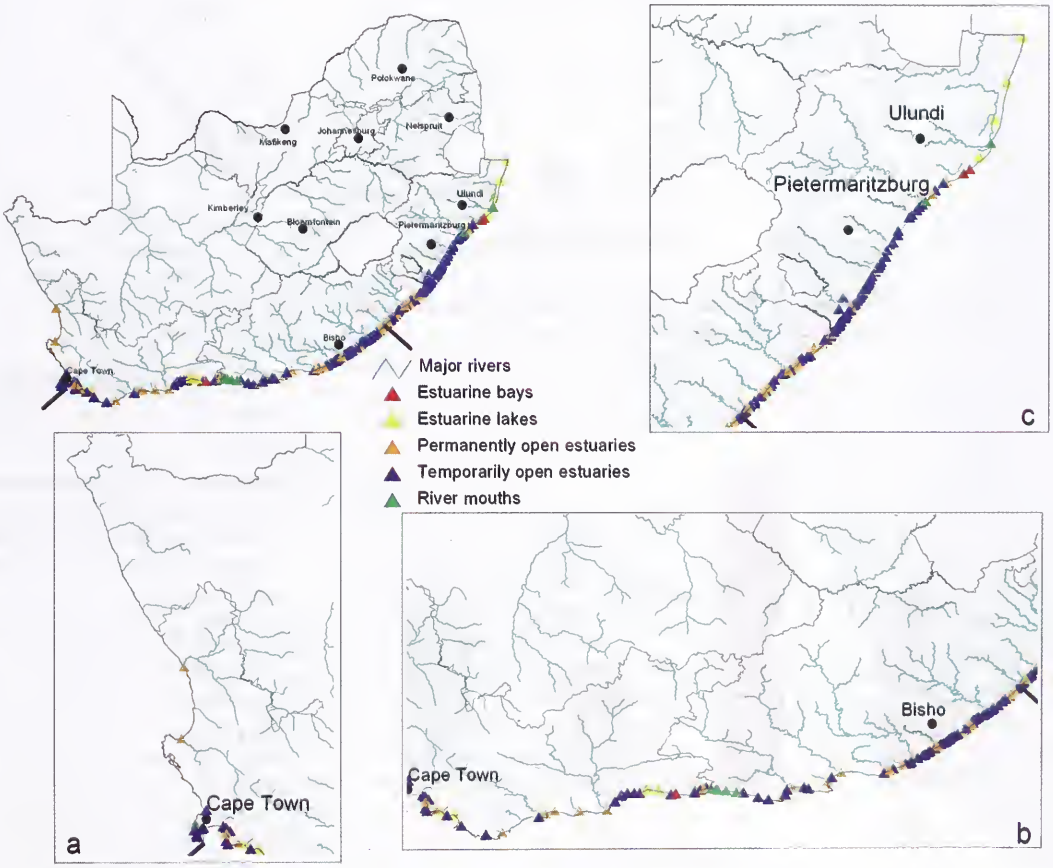


Figure 24: Estuaries in South Africa are sparse in the cool temperate region (a), increasing in density in the warm temperate region (b) and the subtropical region (c).

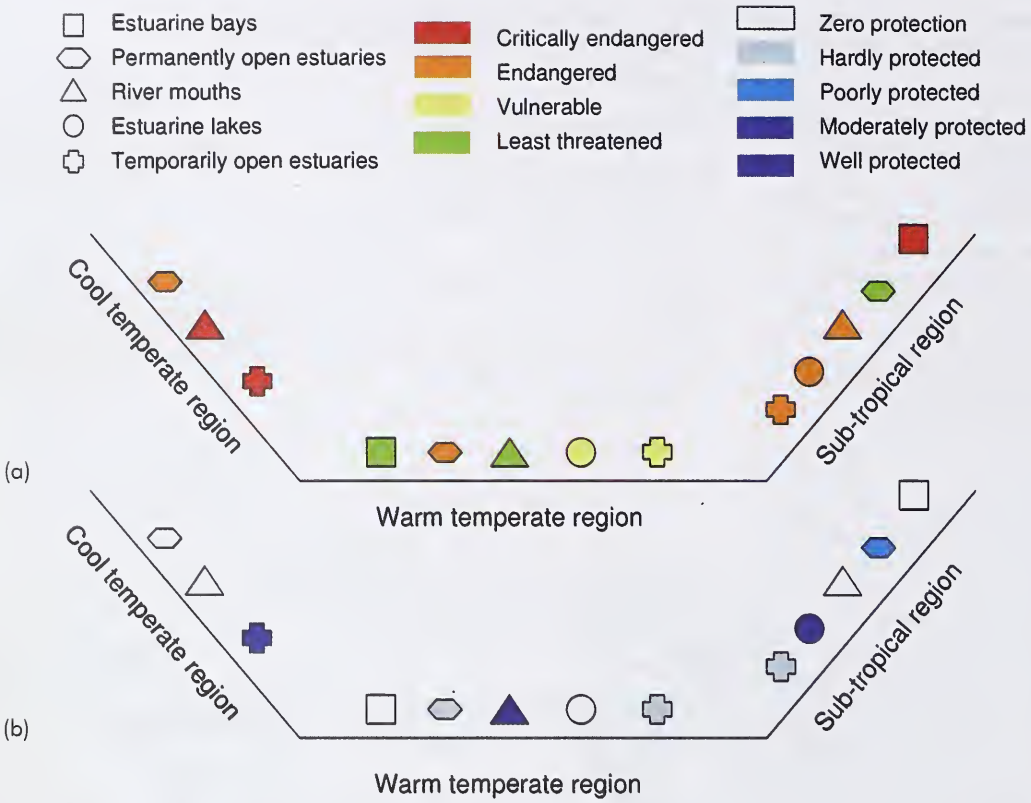


Figure 25: Status and protection levels of estuarine ecosystems. The status of each estuary group is shown in (a), and its protection level in (b).

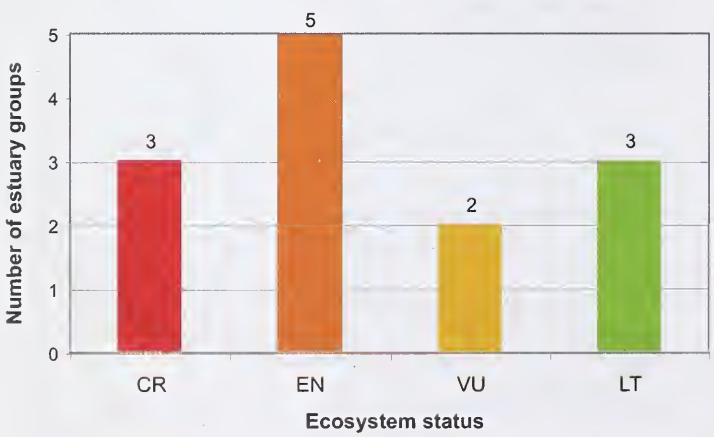


Figure 26: Number of estuary groups per ecosystem status category.

- Increase in freshwater inputs due to agricultural or sewage return flows.
- Reductions in water quality, due to poor catchment management, polluted return flows and effluent disposal.

As indicated in these lists, catchment health is an important factor in estuary health. For example, if there is little natural land cover in a catchment, and much of its water is used for agricultural or industrial purposes, the estuaries linked to that catchment are likely to be in a poor state of health. A general trend is that estuaries fed by larger catchments tend to be in poorer

health than the estuaries in neighbouring smaller catchments. This is partly because larger catchments have larger rivers, and larger rivers tend to be more heavily utilised, and partly because estuaries fed by larger catchments are usually larger, and thus attract more coastal development and other economic activity.

Results of the assessment

We assessed the **status of estuarine ecosystems** based on the 13 groups of estuaries in Table 1 and the estuary health assessment done in 2000. Although 62% of South Africa's estuaries are in good or excellent condition, these healthy estuaries are not distributed evenly across the different groups of estuaries. Some groups of estuaries are more heavily impacted than others, as shown in Figure 25(a). Critically endangered groups of estuaries have few or no estuaries that are still in excellent or good health, and are thus in severe danger of losing biodiversity, functioning and value. Three groups of estuaries fall in this category: cool temperate river mouths, cool temperate temporarily open estuaries, and subtropical estuarine bays. All estuary groups on the west coast are under great pressure. This is partly because there are only a few large estuaries along this coastline, each linked to a major river system and a large catchment that is heavily utilised.

Figure 26 shows the number of estuary groups in each ecosystem status category. Seventy-seven percent of estuary groups are threatened, and 23% are critically endangered. The overall picture is less dramatic than for river ecosystems, but worse than for terrestrial ecosystems.

We also assessed **protection levels of estuarine ecosystems**. Because an estuary is impacted by activities that occur far from the estuary itself, it is difficult to protect an estuary fully. To complicate matters further, terrestrial protected areas tend to include only the upper portion of an estuary, while marine protected areas tend to include only the lower portion of an estuary. There are few estuaries that fall wholly within a protected area, and only five—those in the Tsitsikamma National Park—in which fishing or consumptive use of any kind is totally prohibited. An additional nine estuaries have high levels of protection, for example through restrictions on activities in sections of the estuary, and restrictions on development in the surrounding area. A further 27 estuaries have medium or low levels of protection.

The 14 estuaries with high levels of protection are not distributed evenly across the different groups of estuaries, resulting in some estuary groups that are relatively well protected, and others that are poorly protected, as shown in Figure 25(b). It is useful to compare the protection level of each group with its status.

Priorities for action

All estuaries are highly valuable natural systems that deliver ecosystem services and economic benefits, so the aim should be to maintain all estuaries in a functioning state. Fortunately, many of the human activities associated with estuaries are compatible with their conservation, as long as the activities are managed appropriately. Use and conservation of estuaries can go together. In this context, the following priority actions are identified:

Photo Belinda Reyers

1. Determine, implement and monitor the freshwater reserve for priority estuaries. The National Water Act (1998) makes provision for Resource Directed Measures, which include setting a freshwater reserve for estuaries. Setting this reserve has been carried out for only a handful of estuaries so far. The assessment of status and protection levels of estuarine ecosystems should assist in determining priority estuaries that urgently need to have their freshwater reserve determined and implemented. Those groups of estuaries that are critically endangered *and* not protected at all (for example, cool temperate river mouths) are likely to be of greatest immediate concern. This should be done in conjunction with the Consortium for Estuarine Research and Management (CERM).

2. Expand the number of protected estuaries, to maintain a core set of estuaries in a natural or near-natural state. CERM has identified 32 estuaries that should make up this core set, 11 of which already have some level of protection. Extending appropriate levels of protection to the remaining 21 should be a priority action. This is likely to mean limits to certain human activities in these estuaries, but not necessarily maximum levels of protection. For critically endangered groups of estuaries, it may be important to focus conservation attention on the remaining examples that are in good or excellent health or, in the absence of any healthy estuaries in the group, on rehabilitating at least one estuary in the group.

3. Integrate resource management and land-use planning. As with rivers, integrated planning and management of water and land throughout catchments is a priority if we are to maintain estuary functioning and value. It does not help to protect an estuary itself if, for example, higher up in the catchment effluent flows into the river are at dangerous levels. Ideally estuaries, along with rivers, should be integrated into fine-scale biodiversity assessments, as one step towards achieving this.

How this assessment can be improved

On the whole, information available about South African estuaries is excellent, thanks to the work of our vibrant and committed community of estuary researchers and managers. Nevertheless, several improvements could be made, including the following:

- A review of the estuary classification system, to remove ambiguities and devise a more robust system that will be useful in applied conservation research.
- A quantitative assessment of estuary health. The methods developed for reserve determination need to be applied at a national scale, albeit at a desktop or rapid level if necessary. This will provide a better baseline from which to manage estuaries and determine their freshwater requirements, as well as for monitoring the effects of conservation efforts.
- Quantifying interactions between estuarine and marine ecosystems. Our understanding of estuarine ecosystem functioning is poor, especially with respect to functions such as nursery areas and outputs to the marine zone.

9. Marine biodiversity assessment

Current spatial patterns

Before the NSBA, marine habitats had never been mapped for all of South Africa's waters. There was no consensus on an approach for mapping marine habitats, or even agreement that this was possible, with little spatial assessment ever having been done in the marine environment. The NSBA marine team led a series of workshops with marine managers and experts, in Cape Town, Durban and Port Elizabeth, to agree on an approach, and then gathered the data required to do the mapping. The result is the 34 marine biozones shown in Figure 27.[29] The biozones extend from the coastal (or supratidal) zone to the end of the Exclusive Economic Zone (EEZ), which marks the end of South African waters.[30] They were mapped at a broad scale, with room for refinement in future revisions of the NSBA or in systematic biodiversity plans for particular sections of coast and sea.

Marine species distribution data are limited, more so than for terrestrial species. Nevertheless, we gathered what was available, which included fish distribution data, seaweed data, and data for selected intertidal invertebrates.

The integrity of different marine habitats had also not been mapped prior to the NSBA. We used quantitative expert assessment of the impacts of nine major categories of resource use and other influences on the marine environment, in each marine biozone. Again, marine managers and experts around the country were involved in the process.

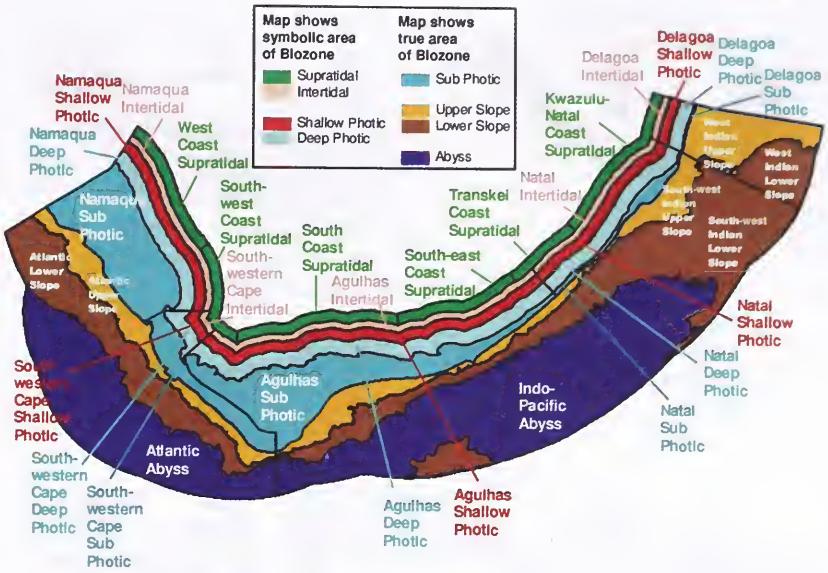


Figure 27: Marine biozones, extending from the coast to the end of South Africa's Exclusive Economic Zone. The supratidal, intertidal, shallow photic and deep photic biozones are not drawn to scale but have been enlarged for display purposes.

The nine major categories of impacts are shown in the thumbnail maps in Figure 28. They are: extractive marine living resource use, pollution (including oil pollution, shipping-related pollution, and many sources of pollution deriving from inland land uses), mining, coastal development, climate change, catchment management issues (including over-abstraction of freshwater and siltation), nonextractive recreational activities (such as off-road vehicles and boat-based tourism), alien invasive species, and mariculture.[31]

[29] We have used the term marine biozones rather than marine ecosystems because of the broad definition of the biozones. They were mapped at a much broader scale than the terrestrial and river ecosystems used in this assessment. There is scope for defining marine ecosystems at a finer scale.

[30] South Africa also holds the Prince Edward Islands in the Southern Ocean. These islands were not included in the assessment.

[31] Mariculture is an important growth industry, and need not have negative impacts if carefully managed. However, if poorly managed, it can result in habitat loss, eutrophication, introduction of invasive species and the spread of disease. Even mariculture based on indigenous species can pose a significant risk to marine biodiversity, with genetically manipulated animals impacting on local stocks when they escape and breed with wild populations. It is important that applications for new mariculture activities are adequately assessed, and that environmental monitoring of existing and new mariculture activities is undertaken.

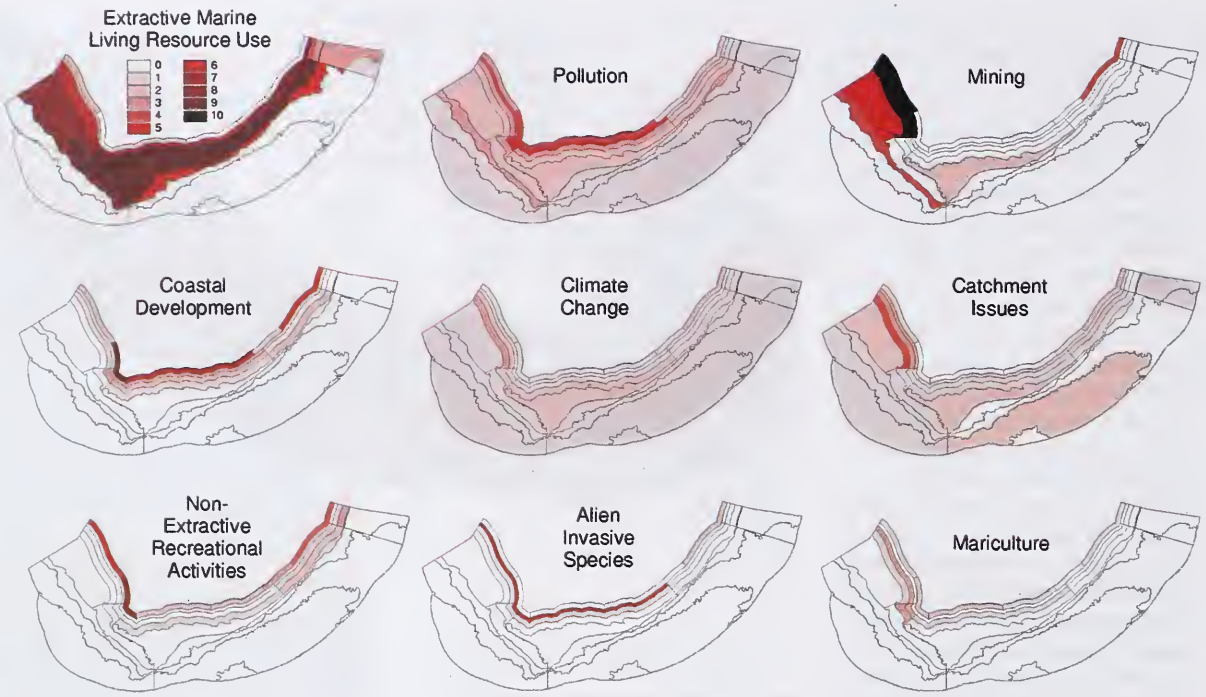


Figure 28: Impacts on marine biozones (current levels, 10 = high impact, 0 = no impact).

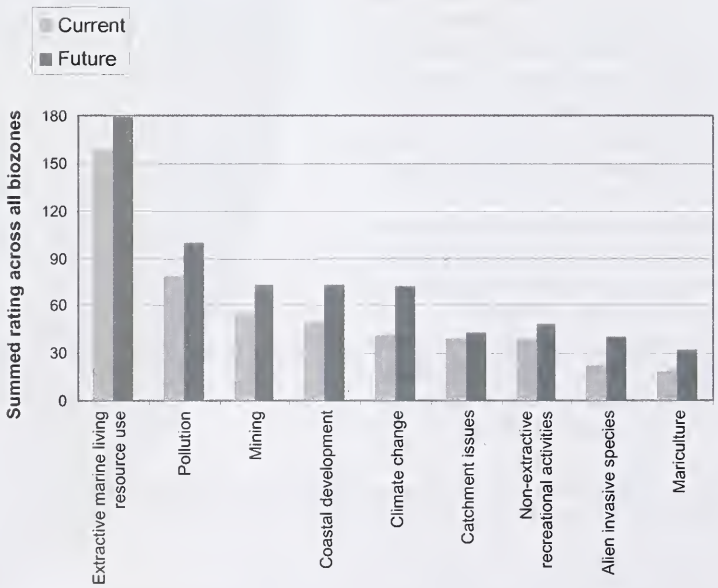


Figure 29: Current and future scores for each category of impacts on marine biozones, summed for all biozones.

A bar graph of total scores for each category shows that overall, extractive marine living resource use is by far the biggest pressure on marine biodiversity (see Figure 29). The main forms of extractive marine living resource use are commercial and recreational fishing. It also includes subsistence fishing, illegal poaching, aquarium trade, ornamental shell trade, magico-medicinal trade and mangrove harvesting.

Extractive marine living resource use directly affects all marine biozones except the abyss, which is too deep to reach using current fishing technology, and has the greatest impacts in areas that are the most accessible. Pollution and mining are the next most serious pressures, but mining is restricted to particular biozones, especially on the west coast where diamond mining is a major activity.

Results of the assessment

We assessed the **status of marine ecosystems**, using the marine biozones (Figure 27) and the current levels of impact on those biozones (Figure 28). The results are shown in Figure 30 and Figure 31. Sixty-five percent of marine biozones are threatened, with 12% critically endangered, 15% endangered, 38% vulnerable, and 35% least threatened.

The critically endangered marine biozones are West Coast supratidal (i.e. coastal), Namaqua intertidal (the area between the high-tide and low-tide marks), Namaqua shallow photic, and Namaqua deep photic. All are part of the broad Namaqua marine bioregion. Both mining and commercial fishing are responsible for the Critically Endangered status of the west coast biozones. The endangered marine biozones include supratidal (coastal) biozones and intertidal biozones, reflecting in large part the impact of extraction of marine living resources. In general, biozones further from the shore are less threatened, as they are less accessible to human-related impacts.

The overall picture for marine ecosystems is less dramatic than for rivers or estuarine ecosystems, but worse than for terrestrial ecosystems. Arguably on the upside for marine ecosystems is the fact that some of the impacts of extractive marine living resource use are reversible, if over-harvesting of marine resources is stopped. For example, as long as fish stocks are still above a certain threshold, they can and do recover if fishing effort is reduced. However, in the course of harvesting marine resources, irreversible damage is often done to the habitat, such as when the sea bed is trawled for fish.

Our marine ecosystems play a vital direct economic role. We need to be careful that in extracting economic value from them now, we do not destroy their long-term productive capacity. All indications are that this is a real danger that faces South Africa.

We also assessed **protection levels of marine biozones**. Figure 32 shows South Africa's marine protected areas (MPAs), which had not been

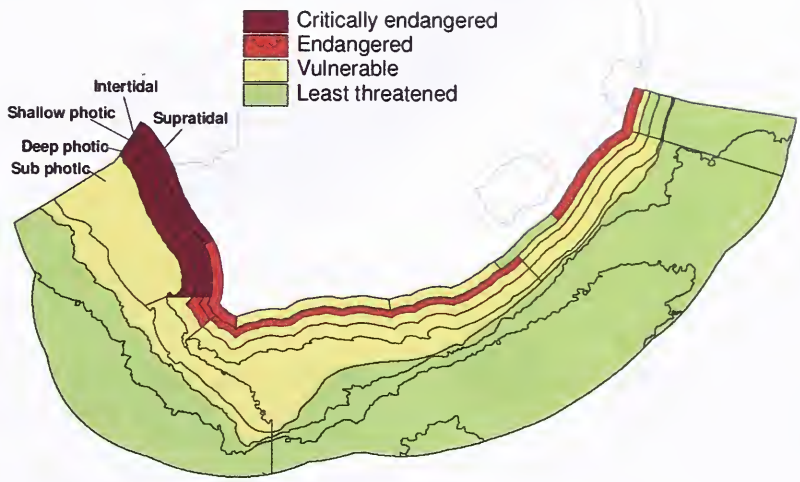


Figure 30: Status of marine biozones.

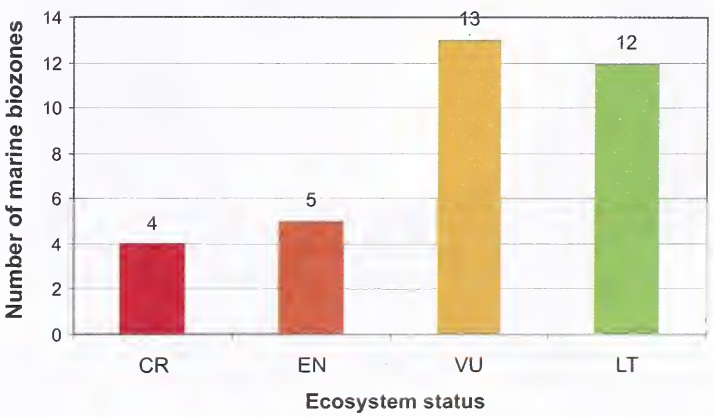


Figure 31: Number of biozones per ecosystem status category.

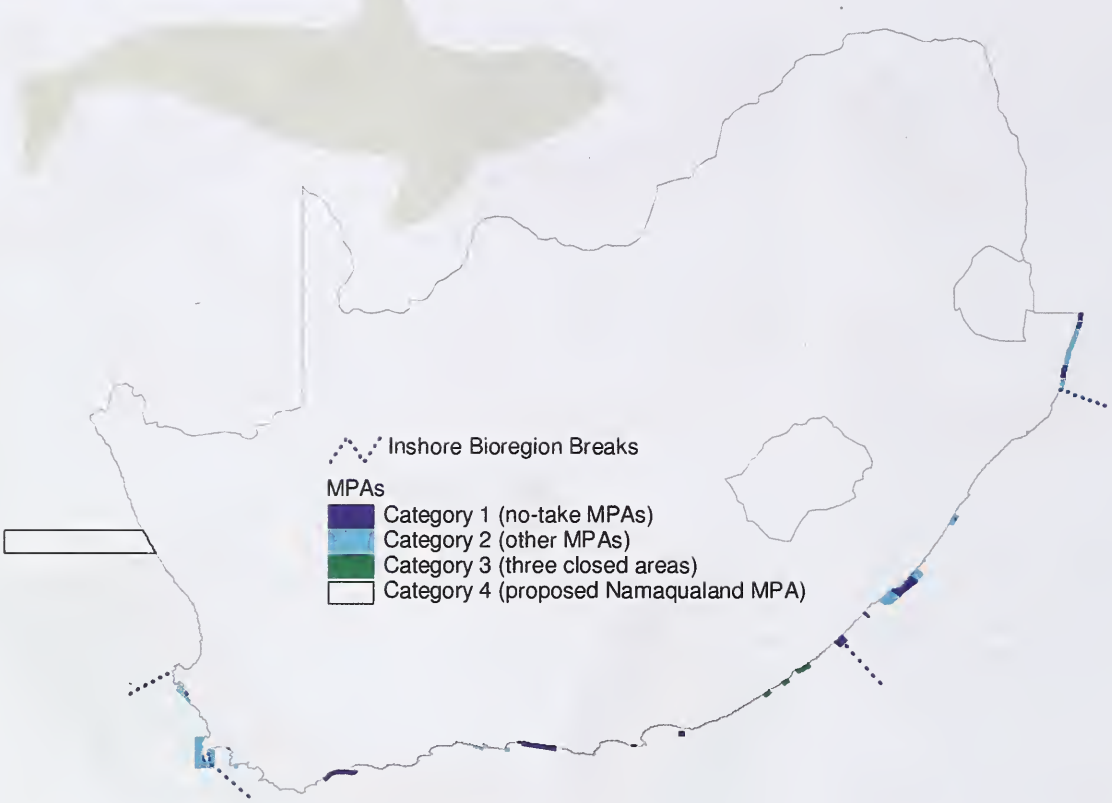


Figure 32: Marine protected areas.

comprehensively mapped prior to the NSBA. The following categories of MPAs are identified:

Category 1: No-take MPAs (MPAs in which no marine living resource extraction is permitted).
Category 2: Other MPAs (MPAs in which some extraction is permitted, e.g. fishing from the shore).
Category 3: Closed areas (the three closed areas near East London).[32]
Category 4: Proposed MPA (the proposed Namaqualand MPA).

Some MPAs are divided into different zones: no-take zones (Category 1) and zones in which some resource extraction is permitted (Category 2). The NSBA marine team also mapped existing MPAs in detail, showing the different zones within each MPA. Figure 33 shows an example from the east coast, giving a close-up of the Pondoland and Aliwal Shoal MPAs.

Based on Category 1 (no-take) MPAs, protection levels of marine biozones were assessed.[33] Figure 34 shows the results. Twenty-three of the 34 biozones have either zero or poor protection. None of the Namaqua biozones are protected, and no part of the lower slope or the abyss in South Africa's EEZ is protected.

[32]Other closed areas exist, for example, areas closed to trawling. These play an important role in protecting marine biodiversity. The three closed areas near East London are the ones most likely to achieve marine protected area status in the near future.

[33]A biodiversity target of 20% of length (for supratidal and intertidal biozones) or 20% of area (for subtidal/offshore biozones) was set, based on the minimum target of 20% recommended for marine habitats by the World Parks Congress in 2003. Well protected biozones have their full target met in a Category 1 marine protected area (or a Type 1 terrestrial protected area for supratidal biozones). Moderately protected biozones have more than half of their target met, poorly protected biozones have between 5% and half of their target met, and hardly protected biozones have less than 5% of their target met. Biozones with zero protection are not included in any Category 1 marine protected areas (or Type 1 terrestrial protected areas in the case of supratidal habitats).

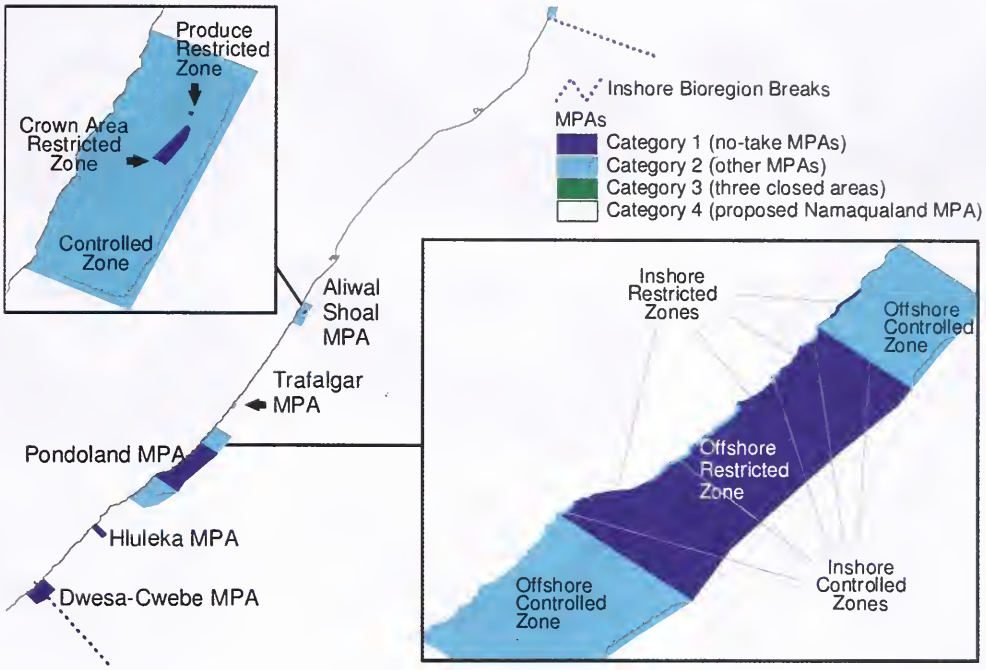


Figure 33: Close-up of the Pondoland MPA and the Aliwal Shoal MPA.

The country's coastline is relatively well protected. However, although 23% of the coastline falls within Category 1–3 MPAs, only 9% of this is no-take. In addition, this 23% is not evenly distributed among bioregions, and is therefore not representative of South Africa's coastal marine biodiversity. The entire Namaqua bioregion (on the west coast) has no MPA, whereas the Delagoa bioregion (south of the Mozambique border) enjoys over 20% protection in no-take MPAs.

Moving away from the coastline, only 0.4% of South Africa's EEZ falls within MPAs, and of this, only 0.2% is no-take. The addition of the proposed Namaqualand MPA to the MPA estate would more than triple the sea surface area under protection, but still bring the total percentage of the EEZ protected up to only 1.3%, well below the minimum 20% recommendations of the World Parks Congress in 2003.[34]

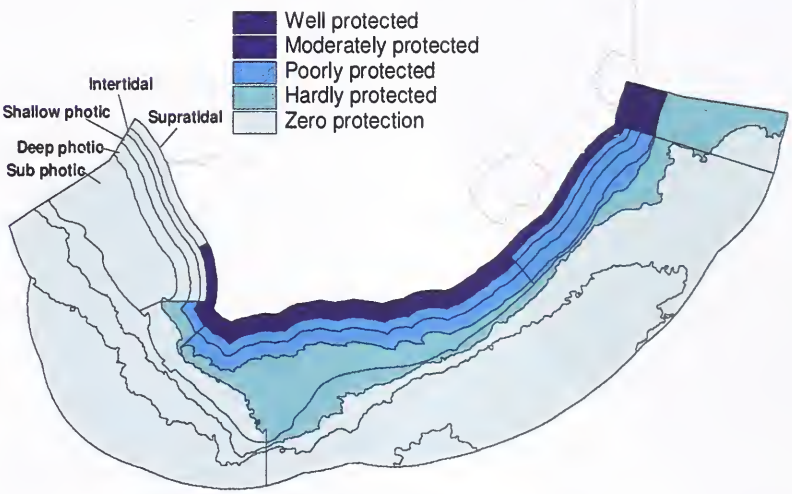


Figure 34: Protection levels of marine biozones.

[34]The 2003 World Parks Congress in Durban recommended that the minimum targets for the protection of marine biodiversity should be 20–30% of each habitat (World Parks Congress 2003 Recommendation 5.22. Stream: Morine).

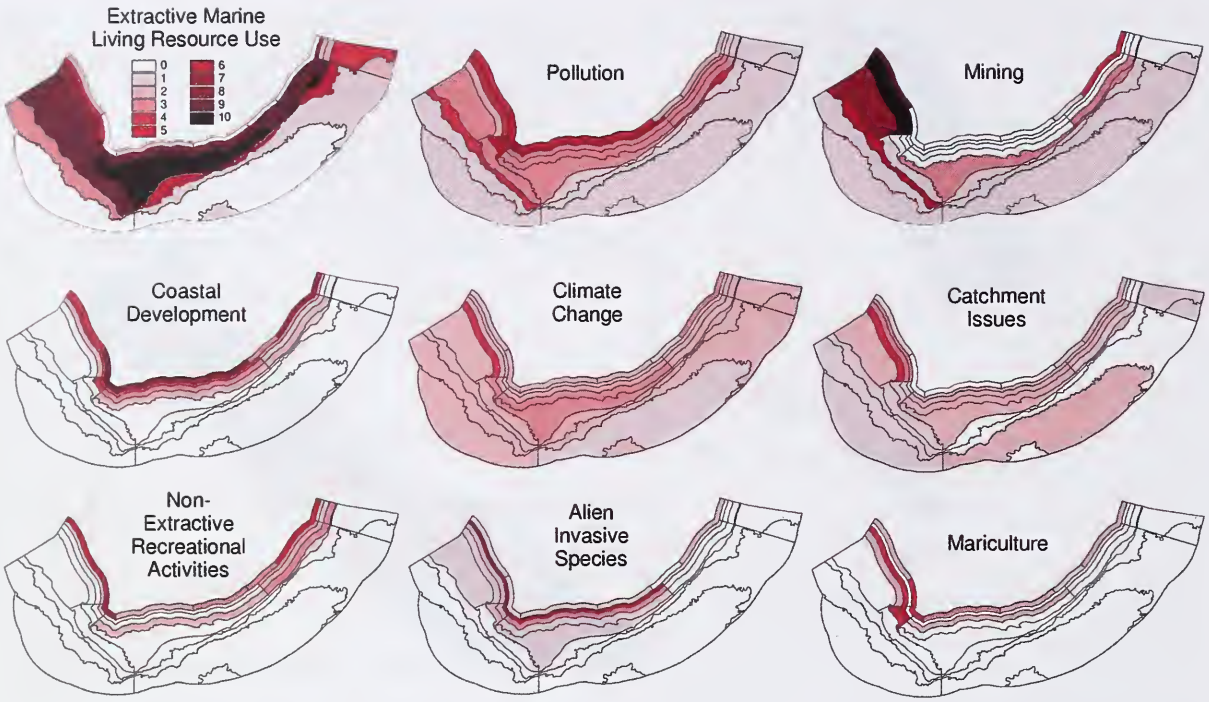


Figure 35: Impacts on marine biodiversity (predicted future levels based on a ten-year time horizon).

Priorities for action

The west coast biozones not only have the least protection (currently zero), but also experience the greatest pressures. Conservation intervention in these biozones is an urgent priority.

As we have emphasised, priorities for conservation action should be informed by our socio-economic context. For the terrestrial component we were able to assess some of the socio-economic opportunities and constraints on biodiversity using available spatial data (see Figure 17). For the marine component, such data were not available, so we asked marine managers and experts to give quantitative estimates of future pressures on marine biodiversity in each of the 34 biozones, based on a ten-year time horizon. The results are shown in Figure 35 and in Figure 29. Future pressures on marine biodiversity follow the same overall pattern as current pressures. The difference is that all are predicted to increase in the next ten years.

In this context, the following set of priority actions to conserve marine biodiversity are suggested:

1. Engage with the commercial fishing industry to find ways to reduce negative impacts on marine biodiversity (both on fish stocks themselves, and on marine habitats, especially soft-bottom trawling grounds), thus contributing to the long-term health of the industry. Owing to the high number of species (~340) used by South African fisheries, more species-level interventions may be required in

the marine environment than in the terrestrial environment.

2. Engage with other industry sectors, including the mining industry (especially the diamond industry on the west coast), the coastal property development sector, and the emerging mariculture industry, to develop and implement sector-specific wise-practice guidelines to reduce impacts on marine habitats.

3. Expand marine protected areas, especially in the Namaqua bioregion, and beyond the coastal region into the deep sea region. Representative protection of the South African EEZ cannot be achieved with coastal MPAs that extend two or three nautical miles offshore. The proposed Namaqualand MPA will play an important role in this regard. We note that MPAs do not always ensure adequate protection of their biodiversity, and more effort needs to go into ensuring compliance within MPAs.

4. As we have stressed in the terrestrial, river and estuarine components, an integrated approach to managing resources at the local level is required, especially for coastal regions not in MPAs. This will require support to coastal municipalities.

How this assessment can be improved

Systematic spatial assessment of marine biodiversity is, like that for river biodiversity, in its early developmental stages, and spatial data for the marine environment are limited. The following would address some of the key information gaps that have limited this assessment:

- Improved mapping of the distribution of marine species, especially fish and species of special concern in other groups.
- Improved classification and mapping of marine habitats, including reefs and sandy beaches.
- Improved mapping of the disturbance and loss of marine habitats, including soft-bottom trawling grounds and coastal access points.
- Identification and mapping of marine ecological processes, such as fish aggregation areas, whale feeding grounds, spawning areas, and upwelling.
- Collation of spatial data on the economic value of marine resources.

As data improve, the assessment can be expanded to more species and more habitats, at finer scales. An additional challenge is to improve our understanding of the moving component of biodiversity in the marine environment (e.g. fish, larvae, nutrients), which is much more difficult to map and thus to deal with effectively in a spatial assessment.

10. Next steps

The NSBA 2004 is a starting point in many ways. It has fed into the NBSAP, and will feed into the National Biodiversity Framework. The Biodiversity Act requires that the National Biodiversity Framework be reviewed every five years, and SANBI's intention is to review the NSBA to fit into this five-yearly cycle. However, it is likely that substantially better information on integrity of terrestrial and marine habitats, and national information on wetlands, will be available sooner than five years. SANBI hopes to update this

Photo Geoff Spiby

Box 5: Proposed National Biodiversity Management Scorecard

Purpose: To provide a five-yearly high-level snapshot of progress on managing South Africa's biodiversity

Example for discussion

	Spatial information about biodiversity features	Spatial information about ecosystem integrity	Ecosystem status	Protection levels	Wise management of ecosystems outside protected areas
Terrestial	B-	C-	C+	C+	?
River	C-	C-	E+	–	?
Wetland	E	E	?	?	?
Estuarine	A	B-	C-	D	?
Marine	D-	E	D-	E+	?

Draft criteria for discussion

Spatial information about biodiversity features (including habitats, species and ecological processes):

- Completeness of data (e.g.: Is the whole country covered, are all taxa covered?).
- Scale of data (Is the spatial scale of the data appropriate for a national assessment?).
- Reliability of data (How confident are we in the data?).
- Recency of data (Are the data up to date?) (Note that different updating timescales are appropriate for different types of data).

Spatial information about ecosystem integrity:

- Completeness of data (e.g.: Is the whole country covered, are all relevant aspects covered? [e.g. degradation in terrestrial ecosystems]).
- Scale of data (Is the spatial scale of the data appropriate for a national assessment?).
- Reliability of data (How confident are we in the data?).
- Recency of data (Are the data up to date?).

Ecosystem status:

- What proportion of ecosystems are threatened?
- To what extent is the loss of ecosystem functioning irreversible?

Protection levels:

- What proportion of ecosystems are well protected?
- Does the protected area network include a representative sample of different types of ecosystems?
- What are the overall levels of protection?

Management of ecosystems outside formal protected areas:

- Criteria to be developed.

assessment when such information becomes available. There is also a need to further integrate the terrestrial, river, estuarine and marine components, for example by identifying overall priorities for all four environments combined. An integrated assessment needs to take into account the critical role of biodiversity in freshwater production, placing freshwater resources at the centre of the planning process.

Another next step is to make links between the NSBA and other spatial policies and planning instruments, such as the National Spatial Development Perspective, and Provincial Spatial Development Frameworks. Even though the NSBA is a national-scale assessment, parts of it are at a fine enough scale to be applied directly in local SDFs, especially in areas where no regional or local systematic biodiversity assessment is available. The terrestrial ecosystem status assessment in particular is relevant at the local scale.

The NSBA provides a tool for ongoing monitoring and reporting on the state of biodiversity. We propose the development of a national biodiversity management scorecard, based on a set of headline indicators drawn from the NSBA. A first attempt is shown in Box 5, to stimulate discussion.

The NSBA is a significant milestone of which South Africa can be proud. The challenge that lies ahead is to translate the biodiversity priorities identified here into conservation action on the ground. This will involve mainstreaming biodiversity priorities in the policies, plans and actions of a wide range of stakeholders whose core business is not biodiversity, but whose day-to-day decisions will ultimately determine whether our development path is a sustainable one.

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Photo Kristal Maze

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Appendix:

Possible Applications of NSBA Products

The main spatial products of the National Spatial Biodiversity Assessment are:

1. Status of ecosystems (identifies which ecosystems are most threatened)
2. Protection levels of ecosystems (identifies which ecosystems are least protected)
3. Future pressures on biodiversity (terrestrial and marine only)
4. Overall priority map

Possible applications of each of these products are listed below.

1. Status of ecosystems

Main applications:

- Identification of threatened ecosystems for listing in terms of the Biodiversity Act.
- Guide for determining which ecosystems need biodiversity management plans in terms of the Biodiversity Act.
- Tool for monitoring and reporting requirements of the Minister in terms of the Biodiversity Act.
- Basis for identifying environmentally sensitive areas in terms of NEMA s24(2)b.

Additional applications:

- Identification of threatened ecosystems can be done by province, district and local municipality, highlighting opportunities for provinces and municipalities to contribute to national biodiversity priorities. For example, municipalities could take threatened ecosystems into account in their rates policies and SDFs.
- Could help to identify municipalities (those with higher numbers of threatened ecosystems) that require support to integrate biodiversity considerations into their IDPs and SDFs.
- Can feed into and inform EMPs and EIPs drawn up by provinces and national departments.

2. Protection levels of ecosystems

- Identifies gaps in the protected area system, providing a basis for national prioritisation of expansion of the protected area network.
- Tool for monitoring the effectiveness of the protected area system, required in terms of the Protected Areas Act.

3. Future pressures on biodiversity

- Flags key land- and resource-use pressures—important for regulating activities in threatened ecosystems, and for determining listed activities in terms of NEMA s24.
- Highlights industrial and other sectors with which to enter into environmental management co-operation agreements, in priority areas.
- Highlights areas of potential conflict with other major land-

use departments, e.g. Agriculture, so that conflicts can be pre-empted.

- Gives the Minister a 'regional context' tool for assessing the impact of large development proposals.

4. Overall priority map

- Guide for bioregional planning: highlights areas where bioregional plans and/or provincial spatial biodiversity plans are urgently required.
- Highlights opportunities to link biodiversity to regional development priorities.
- Provides a focus for government land management programmes such as NAPCCD and LandCare.
- Highlights areas in which clearing of invasive aliens supports the achievement of biodiversity conservation targets.
- Feeds directly into the other NBSAP components.

In addition, the NSBA's analysis of **species of special concern** can be used to:

- Provide a guide for drawing up provincial and national threatened and protected species lists required in terms of the Biodiversity Act.
- Provide a guide for deciding which biodiversity management plans for species should be developed and approved in terms of the Biodiversity Act.

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This report forms part of a set of five reports on South Africa's National Spatial Biodiversity Assessment 2004. The full set is listed below, and is available at www.sanbi.org.

NSBA Summary Report

Driver, A., Maze, K., Rouget, M., Lombard, A.T., Nel, J., Turpie, J.K., Cowling, R.M., Desmet, P., Goodman, P., Harris, J., Jonas, Z., Reyers, B., Sink, K. & Strauss, T. 2005. National Spatial Biodiversity Assessment 2004: Priorities for Biodiversity Conservation in South Africa. *Strelitzia* 17. Pretoria: South African National Biodiversity Institute.

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This report presents the results and recommendations of South Africa's first National Spatial Biodiversity Assessment (NSBA). The NSBA is the first ever comprehensive spatial assessment of biodiversity throughout the country. It has four components, dealing with the terrestrial, freshwater, estuarine and marine environments.

The NSBA should inform the policies, plans and day-to-day activities of a wide range of sectors, both public and private. It is hoped that the spatial products presented in the report will be widely used and built upon. The challenge that lies ahead is to translate the biodiversity priorities identified here into conservation action on the ground. This will involve mainstreaming biodiversity priorities in the policies, plans and actions of a wide range of stakeholders whose core business is not biodiversity, but whose day-to-day decisions will ultimately determine whether our development path is a sustainable one.